MARTINSDALE WIND POWER PROJECT WILDLIFE ASSESSMENT

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MARTINSDALE WIND POWER PROJECT ASSESSMENT

EXECUTIVE SUMMARY

Horizon Wind Energy, LLC (Horizon), on behalf of Martinsdale Wind Farm, LLC, a wholly owned subsidiary of Horizon engaged the services of Ranchland Wildlife Consultants, Inc. to calculate a potential impact index (PII) and complete baseline avian, wildlife, habitat, and sensitive species studies for the proposed Martinsdale Wind Power Project (MWPP) area, located in Meagher and Wheatland Counties, Montana. The PII and biological studies were performed to characterize the existing environment and provide information needed to assess the potential impacts of developing the MWPP. Following Interim Guidelines developed by the U.S. Fish & Wildlife Service (USFWP), a potential impact index (PII) for the proposed Martinsdale Wind Power Project, 11 km north of Martinsdale, Montana was completed in autumn 2006. PII was a subjective indicator of relative risk of wind farm development to vertebrate wildlife and resulted in a score of 0.53, which was ranked **MODERATE** relative to a "worst case scenario" location evaluated in Montana. Questions, conditions, or problems not fully obvious, understood, or in need of verification or clarification that arose during the PII process were used to identify and focus objectives of the preconstruction study plan. Objectives focused on determining breeding bird and bat densities, seasonal big game use, identification of specially protected species on and around (w/in 7 km of) MWPP, and vertebrate mortality associated with existing turbines near MWPP. Other objectives perfunctory or recommended for most pre-construction assessments of wind sites were included or added. Methods included point counts, aerial and pedestrian raptor nest surveys, road surveys for raptors, pedestrian transects, literature review, agency interviews, employment of bat echolocation detectors, and incidental observations. In addition, a brief feasibility study of integrating marine surveillance radar, thermal infrared imaging (IR), and acoustic ultrasound (bat echolocation) detectors to determine presence and location of bats was included. Eight hundred forty-two (842) individual birds, 41 species, and one unidentified individual were recorded during point counts. Horned larks, vesper sparrows, western meadowlarks, red-winged blackbirds, and brown-headed cowbirds were most common. Grassland transects averaged most birds per count (9.6) but lowest diversity (4). Forested transects averaged 20 species with 7.3 birds present per count. Riparian habitats averaged 22 species with 13.4 birds per count. Two active golden eagle nests were found on the MWPP, one on the east and one on the west timbered bluffs. American kestrel nest cavities, an occupied ferruginous hawk nest, and three northern harrier nests were found on or near MWPP. Although no burrowing owls were observed, the project site does provide

suitable habitat (burrows). Northern Harriers and Greater sandhill cranes were frequently observed dispersed along Daisy Dean Creek and likely nests are present. Long-billed curlew were observed daily in farm fields and grasslands but no nests were located. Eleven male sage grouse were observed displaying approximately 3 miles North west of the boundary of MWPP, however no sage grouse were observed on the MWPP. Four Seasonal Raptor Survey Routes were conducted a mean of 6.75 times per season. Mean length was 29 mi. Mean number of raptors/mi for all seasons was 0.289 (n = 4). American kestrels were most abundant per mile (0.9), followed by red-tailed hawks (0.6), and Golden eagles (0.5). Integrative bat monitoring using radar, IR, and bat detectors was conducted on two nights in late spring and 3 nights in early autumn. Bats were detected by both IR and bat detectors but could not ever be confirmed as the same bat. Radar signatures were displayed coincident with IR or acoustic detections but could not be determined to be the same bat. Radar signatures did not display any unique characteristics that would identify them as bats or birds. Recordings of bat echolocations were obtained at 6 locations in and around MWPP. Sonobat computer software was used to analyze 130 recordings for species identification. Species identified were big brown bat, silver-haired bat, western small-footed bat, little brown bat, California bat, fringed bat, long-legged bat, and spotted bat. No carcasses, feather spots or other evidence of bird mortalities were found around existing wind turbines during mortality surveys. Five species of big game animals were observed within or near the MWPP: Mule deer, American pronghorn, Rocky Mountain elk, white-tailed deer, and Black bear. Mule deer, and pronghorn were observed every month of surveys but use was greater in autumn and spring, suggesting MWPP is important transitional habitat for both ungulates. No state or Federal endangered or threatened species or candidate or proposed were found on or near MWPP. Sixteen sensitive species were found on or near the MWPP. Bald and golden eagles and ferruginous hawks were the only species observed on or near MWPP that were protected under the auspices of Bald and Golden Eagle Protection Treaty Act (BEPA), Migratory Bird Treaty Act (MBTA), or considered Species of Special Concern. Conclusions and discussion of assessment follow. Mitigation recommendations are provided.

PRIMARY PURPOSE

The primary purposes of pre-project assessment studies are: 1) collect information suitable for predicting the potential impacts of the proposed project on wildlife and 2) provide recommendations for the project layout (e.g. turbine locations) so that impacts on biological resources are avoided and minimized. The purpose of this biological assessment is to provide technical information and to review the proposed project in sufficient detail to determine to what extent the proposed project may affect wildlife species and important habitats.

The document presents technical information upon which later decisions regarding project impacts are developed. Information provided includes the habitat types that will be affected by the project, sensitive species known or that have potential to occur on the property site and potential impacts to those species, special jurisdictional habitats (i.e. Waters of the United States), and finally recommended mitigation measures to minimize or alleviate potential project impacts.

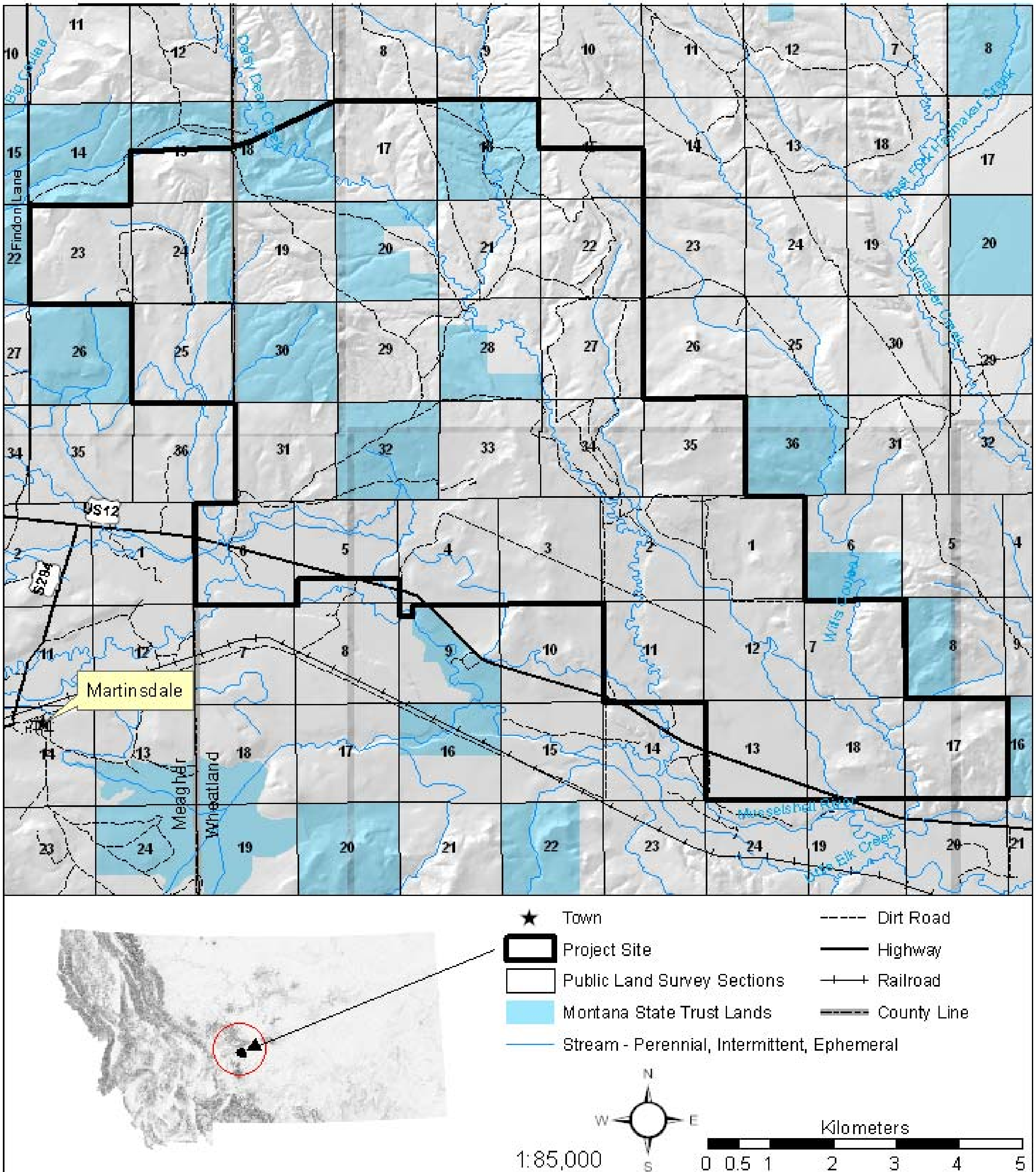
The proposed project being reviewed for development is the Martinsdale Wind Power Project. We were informed that proposed turbine siting locations were concentrated in primarily: 1) cultivated fields atop two prominent buttes (elev. ~ 1614 m) with steep slopes covered in mostly ponderosa pine (*Pinus ponderosa*) descending to cultivated fields approximately ~ 90 m below; 2) flat benches astride Daisy Dean Creek between the two buttes (elev. ~ 1499 m) and; 3) that turbines would be placed in rows in the above areas.

PROJECT LOCATION

The proposed project site is located in both Meagher and Wheatland Counties of Montana. Total acreage of the project site is approximately 26,000 acres. A major portion of the project Martinsdale Wind Resource Area (MWPP) is owned by the Martinsdale Heutterite Colony, while the remainder of the Site consists of Montana State Lands (Fig. 1). It is approximately 15 miles north/northeast of the unincorporated community of Martinsdale and may be accessed from both State Highway 12 and Findon Lane.

The land uses of the Site consist primarily of rangeland grazing, dryland farming, surface mining for rock and gravel, big game hunting, and multi-family residential. The property is extensively fenced and cross-fenced for sheep and cattle grazing. Fencing consists primarily of five-strand barb-wire and three to four strand electric wire fences.

All currently existing land uses are expected to continue during and after development of the wind energy project. The wind turbine type have not been determined but the structure height when the rotor blades are included will be predictably less than 420 feet even if the largest turbines are employed on the project site. That would be the "worst case" situation. The rotational speeds on the turbines that may be used are about 14-17 rpm. An exact project description with a representative map layout was not available at the time of this report writing. Access road development would occur and include grading along existing dirt roads that currently provide access to farm lands and hunting areas. New access road development would be required.



Martinsdale Wind Resource Area Project

Figure 1 Project Site Location Map

Wild West Ecological Consulting, Inc.

December 15, 2007

APPLICABLE LAWS

Federal laws

Endangered Species Act (ESA)
Bald and Golden Eagle Protection Act (BGEP)
Migratory Bird Treaty Act (MBTA)
Section 404 of the Clean Water Act

Montana State Laws

Montana Environmental Policy Act (MEPA)

Biological & Geological References

Standard references and field guides were used to identify wildlife species and assist in evaluation of potential for occurrence of sensitive species. For currently accepted names of wildlife species, Wilson and Ruff (1999) was referred to for mammals; the AOU check-list of North American birds (www.aou.org/checklist/) was referred to for birds; and Stebbins (2003) was referred to for amphibians and reptiles. The Montana Natural Resource Information System (www.nris.mt.us) was used for identification of significant geologic features, including the status of Daisy Dean Creek (Fig.1). NRCS web site (www.mt.nrcs.usda.gov) provided information on soils and geology for the project site.

PHYSICAL CONDITIONS

Geography

The project site is located on the western edge of the Northwest Great Plains. To the north northwest is the Little Belt Mountains, to the south the Crazy Mountains (a.k.a. Crazy Woman Mountains), and to the southwest are the Castle Mountains. Further to the west lies the Continental Divide along the northern Rocky Mountains. The project site is characterized by rolling grassland prairies or plains, forest-sided buttes, sagebrush steppe, and mountain-fed streams.

Climate

The project area is characterized by a continental climate (Stoddard et, al, 1975). A dry climate, summer days are generally warm with cool nights, while winters are cold. Prevailing winds from the west are forced over the Rocky Mountains and as these winds move upslope they expand and cool, causing water vapor to precipitate out. This dry air then passes over the crest and begins to move downslope, while accelerating in speed and warming in temperature. The result for the east side of the mountains, including the project area, is a rain shadow effect and foehn winds. Foehn winds are strong, gusty, warm, and dry. In the winter, these foehn winds are known as Chinook winds, which have a warming effect primarily by replacing cold air masses and inhibiting the formation of inversion layers.

Average annual precipitation for the Martinsdale area has been about 13 inches. The rainiest months are May and June, experiencing on average about 2.35 inches during each of those months. Average annual snowfall amounts to almost 60 inches, however snowfall accumulation is low, usually averaging only a couple of inches in depth. This low level of snow accumulation is also related to the foehn winds which can quickly melt and evaporate snow due to the warm temperature and relatively low humidity.

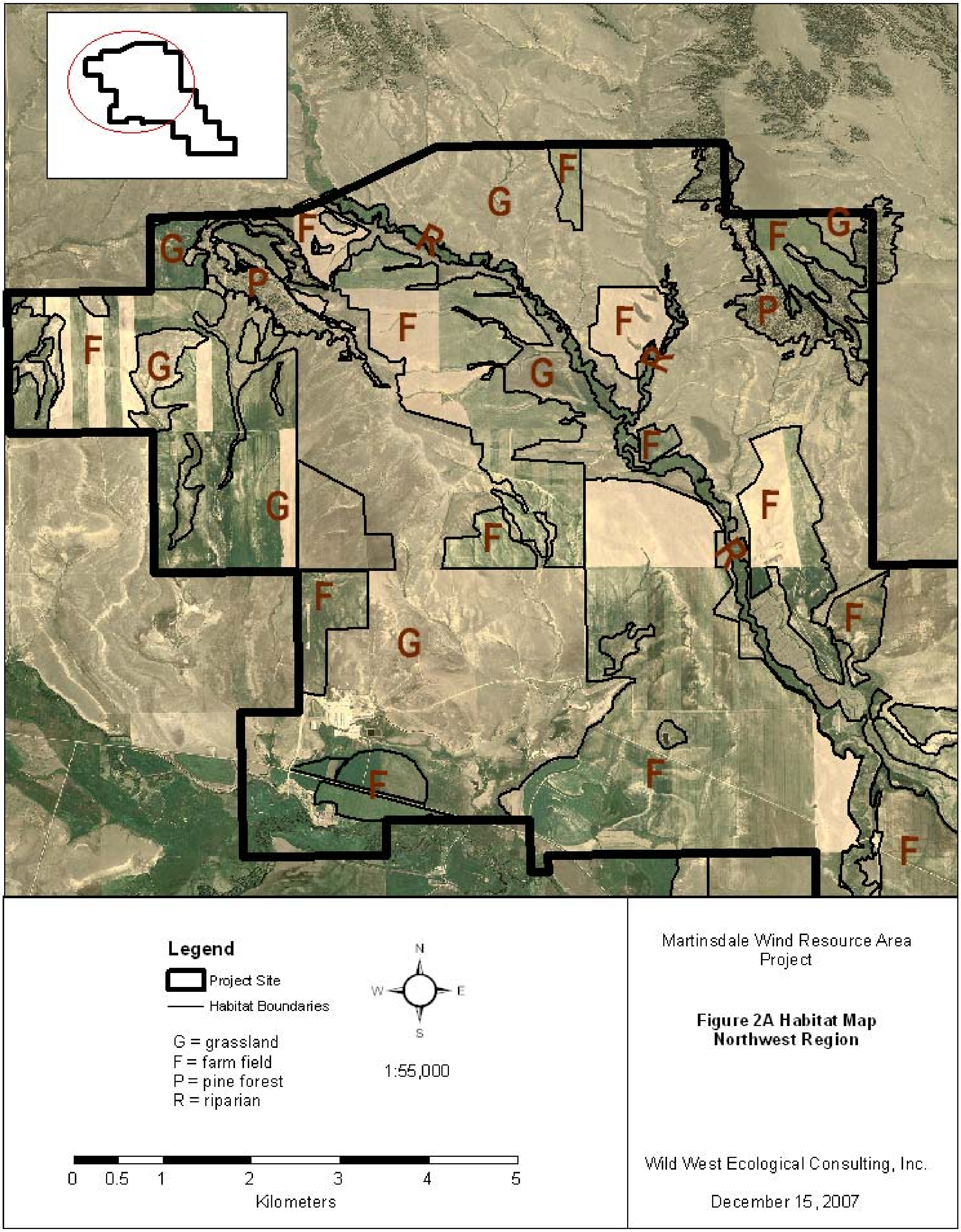
Maximum summer daytime average temperatures have been in the low 80s (^{0}F), while summer nights have remained cool in the mid 40s (^{0}F) on average. The coldest month of the year on average is January with daytime temperatures usually in the mid 30s (^{0}F), with nights dropping down to an average of about 12 (^{0}F).

Soils
The Project site is underlain by Mesozoic and Paleozoic sedimentary rocks that include carbonates and Quarternary terrace deposits. Soils consist of Mollisols, Alfisols, Entisols, and Inceptisols. The first two soil types are very productive, while the latter two types of soils are very acidic.

Hydrology
The Musselshell River and Daisy Dean Creek are both identified as permanent blue line streams by the USGS. As such, they are under the jurisdiction of the USACE because they qualify as Waters of the United States (US). Road improvement projects that involve either Daisy Dean Creek or the Musselshell River will require a wetland delineation review and a permit from the USACE.

PRIMARY HABITAT TYPES

Primary Habitat Types here are five primary habitat types located on the project site. The habitat types present on the property include ponderosa pine forest, short grass prairie, dryland farm land, sagebrush steppe, and riparian. In addition to these primary habitat types, there are sub-habitats, particularly in the riparian habitat category. These include riparian woodland forest, riparian willow/shrub habitat, tall emergent marsh, and short emergent marsh. Riparian habitat includes open water located within riparian habitats (Fig.2A & Fig.2B).


G
F
R
P
Legend
Project Site
Habitat Boundaries
G = grassland
F = farm field
P = pine forest
R = riparian
N
W
E
S
1:55,000
0
0.5
1
2
3
4
5
Kilometers
Martinsdale Wind Resource Area Project
Figure 2A Habitat Map Northwest Region
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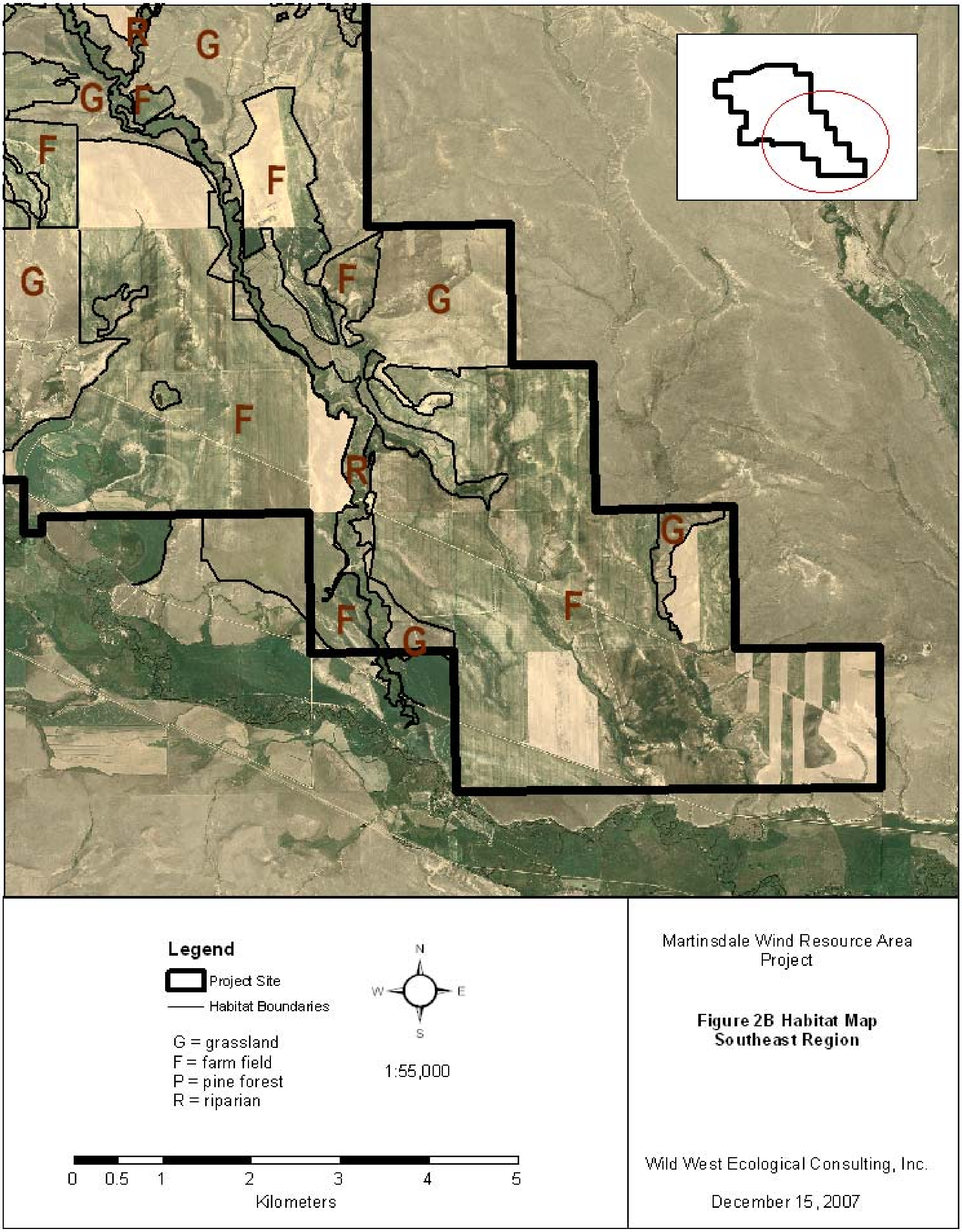
December 15, 2007



Martinsdale Wind Resource Area Project

Figure 2B Habitat Map Southeast Region

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Ponderosa Pine
The ponderosa pine forest habitat is heavily used by cavity nesters, including mountain bluebird, mountain chickadee, white-breasted and red-breasted nuthatches, American kestrel, great horned owl, and northern flicker. Other common wildlife species of the ponderosa pine forest habitat include American black bear, North American porcupine, rock pigeon, western wood peewee, Clark's nutcracker, black-billed magpie, chipping sparrow, and pine siskin.

Short Grass Prairie
Short grass prairie habitat in the project area is dominated by graminoids. Historically this habitat would likely to have been dominated by blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*), but it has been invaded by non-native species including Cheatgrass (*Bromus tectorum*) and Crested Wheatgrass (*Agropyron desertorum;Agropyron crisatum*).

Many species use the Short Grass Prairie habitat for hunting grounds, including golden eagle, red-tailed hawk, American kestrel, prairie falcon, and peregrine falcon. Ferruginous hawks and northern harriers not only hunt, but nest in this habitat as well. Other common wildlife species of the Short Grass Prairie habitat include pronghorn antelope, Richardson's ground squirrel, and white-tailed jackrabbit.

Sagebrush Steppe
This habitat type occurs on those portions of the more northern and western portions of the site that are closer to the foothills of the Little Belt Mountains. The dominant shrub species here is big sagebrush (Artemisia tridentate) with an understory dominated by graminoid species.Wildlife species that are known to predominantly utilize the sagebrush habitat at the site include greater sage grouse, clay-colored sparrow, Brewer's sparrow, white-crowned sparrow, and mountain cottontail. For these species the sagebrush steppe habitat provides cover, nesting habitat, and feeding grounds.

Riparian
The riparian habitat of the project site includes several sub-habitat types, including riparian forests along the Musselshell River dominated by cottonwoods (*Populus* spp.) with a willow (*Salix* spp.), chock cherry (*Prunus virginiana*), and emergent wetland vegetation understory; riparian shrublands along Daisy Dean Creek, usually dominated by willow species but also occasionally dominated by other shrub species such as snowberry (*Symphoricarpos* sp.) or silver sage (*Artemisia cana*); tall emergent wetlands dominated by a variety of species including cattails (*Tule* spp.), western wheatgrass (*Pascopyrum smithii*), or bulrush (*Scirpus* spp.); and open water habitat.

The riparian habitat along Daisy Dean Creek has been severely degraded from overgrazing. There are no woodlands, most of the trees probably having been cut down in the past and since have been unable to re-establish due to grazing. Cover from shrub species are much less dense than it should be under more natural conditions. Banks are eroding and sediment loads in the stream are high. Water quality is expected to be poor, with a high *E. coli* count and *Giardia* present.

Many species of songbirds and swallows utilize the project site's riparian habitat. Songbird species that were frequently sighted in the riparian habitat include willow flycatcher, gray catbird, yellow warbler, song sparrow, savannah sparrow, red-winged blackbird, and Brewer's blackbird. Many waterfowl species utilize those areas with open water and some nest near the stream edges in cover provided by riparian, including mallard, American widgeon, gadwall, cinnamon teal, blue-winged teal, green-winged teal, northern pintail, and common merganser. Other wildlife species that take advantage of the food and shelter provided by riparian habitat include white-tailed deer, mule deer, muskrat, raccoon, and garter snakes.

Dryland Farm/Farm Field

Short grass prairie habitat over much of the project site was converted to farm fields for the purposes of crop production. The primary farm field crops on the site and in the vicinity are winter wheat, corn and alfalfa. Although farm fields are not native habitat, they do provide habitat elements that are utilized by some wildlife species. The species richness of farm fields is less than that of the native habitats. Wildlife species that utilize the farm fields on site include sandhill crane, long-billed curlew, gray partridge, horned lark, killdeer, brown-headed cowbird, and pronghorn antelope.

PII EVALUATION

In 2006, we conducted a survey of a portion of a proposed wind resource area (WRA), centered 11 km north of Martinsdale, Wheatland County, Montana (Fig. 1), identified hereafter as Martinsdale Wind Power Project (MWPP). The area surveyed was composed primarily of private land and state lands. We followed Interim Guidelines developed by the U.S. Fish & Wildlife Service (www.fws.gov/r9dhcbfa/windenergy. html) to develop an index of potential impact of MWPP to vertebrate wildlife. The impact assessment process (Process) included calculation of a Potential Impact Score (Score) which when ranked relative to a "worst case scenario" location evaluated in Montana, produced a Potential Impact Index (PII). Following are the results of the Process and identify concepts, questions, and problems that needed to be addressed in a Pre-construction Study Plan (PSP).

PII Impact Assessment Process

Emphasis of the Process was on ***initial site evaluation*** and intended to provide more objectivity than simple reconnaissance surveys. PII is an ***indicator of relative risk to vertebrate wildlife*** and thus the level of impact that may be expected should the MWPP be developed. A PII also is suggestive of rigor and scope of additional study needed. Assumptions implicit in the process are:

1. All wind farms, regardless of turbine design, configuration or placement, present potential hazards and risk to vertebrate wildlife from both an individual and population perspective.

2. Some sites present less hazard and risk to vertebrate wildlife than others.

3. No adequate and defensible information exists regarding appropriateness of the proposed wind site being evaluated, relative to impact on vertebrate wildlife.

4. Evaluations are conducted by qualified biologists and should involve state and federal agencies who are familiar with local and regional vertebrate wildlife.

The primary determinate of Process is evaluation of potential impacts on aerial wildlife resources (birds and bats) from a collision (turbines and infrastructure) risk perspective. In addition, the Score considers potential impacts of development on terrestrial and aquatic species listed as Threatened, Endangered, or Candidate species (TE&C) that occur in Montana (USFWS 2001a & b) and Species of Special Concern (SCS) as listed by the Montana Natural Heritage Program (MNHP 2001).

The Score is derived from results of three checklists (Appendix I). Specific instructions for completion of each checklist immediately follow the respective checklist in the Appendix. A PHYSICAL ATTRIBUTE checklist considers topographic, meteorological, and site characteristics that may influence bird/bat, TE&C, and SCS species occurrence and movements. A SPECIES OCCURRENCE & STATUS checklist contains ***all*** TE&C and SCS and includes compiled results from companion species-specific Avian and Bat checklists. An ECOLOGICAL ATTRACTIVENESS checklist evaluates the presence and influence of ecological magnets and other conditions that would draw birds and bats to the site or vicinity. Cells in each checklist are checked based on known or perceived occurrence. Conditions pertinent to some cells may or may not be present and thus a “?” is entered. Cells with “?” are treated as a check in totals, but are explored further in the SITE SPECIFIC COMMENTS sheet.

Critical to determining pre-construction study needs are questions (*i.e.*, cells with “?”), and other statements, comments, or concerns regarding any checklist cell or category included on the SITE SPECIFIC COMMENTS sheet. These comments help identify and refine questions and objectives that should be addressed by follow-up study and monitoring. The Score was derived from combining totals of all checklists and adjusting for unequal proportions. Increasing Scores are indicative of increasing potential for impact of development but there is no threshold Score indicative of “unsuitable for development”.

The Score was used as a basis to assign PII of the proposed MWPP. The PII is relative to the maximum Score achieved from analysis of five reference sites evaluated (not proposed as WRAs). Reference sites were chosen because they were suspected to generate a near maximum or, near minimum possible Score. Reference sites were used as benchmark because all cells would never be checked in a real-life situation. Ecological and physical conditions that would permit it do not exist in Montana (i.e., Cassin's kingbird (Tyrannus vociferans) & grizzly bear (Ursus arctos) ranges do not overlap and all topographical categories cannot exist in one WRA). Score of the MWPP was assigned a rank based on proportional relationship to the maximum reference site Score (291). Five impact rank categories (VERY LOW, LOW, MODERATE, HIGH, VERY HIGH) were arbitrarily set at increasing intervals of 20% of maximum Score.

Potential Impact of Martinsdale Wind Resource Area

MWPP Score was **0.53**. PII of MWPP was therefore ranked as **MODERATE** (Appendix Fig. 1). Ranking resulted primarily from diversity of habitat (cultivation, grassland, lentic and lotic systems, forests) in proximity to the proposed turbine string locations rather than observations of TE&C, SCS, or abundant birds and bats. Several questions pertinent to the use of the area by migrant birds and bats (*i.e.,* checklist cells with "?") may have artificially inflated the Score.

Identification of Pre-Construction Study Needs

Questions, conditions, or problems not fully obvious, understood, or in need of verification or clarification were identified and recorded in SITE SPECIFIC COMMENTS and focus objectives of the pre-construction study plan. Circumstances that prompted questions follow the specific questions derived from SITE SPECIFIC COMMENTS below. Additionally, current strategies recommended by industry (*e.g.*, The National Wind Coordinating Committee protocols and guidelines, http://www.nationalwind.org/publications/wildlife.htm and The Developer's Perspective, www.abanet.org/ environ/committees/renewable energy) and conservation organizations indicate pre-construction studies should address the certain objectives as perfunctory prior to any WRA development. Site specific questions and industry and conservation organizations objective form the basis of preconstruction study objectives here.

Question 1.

What is the level of use of MWPP and vicinity by migrant birds and bats? *Circumstance:* Most seasonal migrant birds and bats tend to migrate in high densities latitudinal (*i.e.,* north to south & vice versa), along corridors associated with topographical features (ridgelines, mountain chains, valleys) perhaps present in and around MWPP.

1a. Is there any avian vertebrate mortality associated with existing turbines?

Circumstance: Wind turbine rows exist within 2 km of proposed development. Searches for dead birds and bats (mortality searches) around existing turbines in the vicinity of proposed MWPP development may give an index of expected mortality, if any.

Question 2.
Do ferruginous hawks (*Buteo regalis*) and burrowing owls (*Speotyto cunnicularia*) nest in the vicinity? *Circumstance:* Both of these raptors are Species of Special Concern as listed by the Montana Natural Heritage Program and sensitive to human presence and perturbation of habitat. MWPP is within the breeding range of both species and contains habitat conditions conducive to their presence (flat, open grassland, ground squirrel (*Spermophilus spp*.) and badger (*Taxidea taxus*) burrows, erosional remnants, escarpments, low profile coniferous and willow (*Salix spp.*) stands). No data exist as to whether the greater MWPP and vicinity is host to breeding ferruginous hawks or burrowing owls.

Question 3.
What is species composition and abundance of bats during the breeding season? *Circumstance:* Studies at existing wind sites suggest the most significant habitat variable associated with bat mortalities is proximity of turbines to forested ridges. Tops of two buttes within MWPP (Fig. 1) are planned to support wind turbines. The butte slopes are covered by healthy stands of conifers that may support foliage roosting/nesting bats. Additionally, summer foraging bats may travel up to 19.2 km from their broods. Timber stands within the Lewis and Clark National Forest are within 9.6 km from MWPP and may support breeding hoary bats. MWPP may be in the foraging range of hoary bats. No data exist as to whether the greater MWPP and vicinity is host to breeding bats.

Industry (*e.g.,* The National Wind Coordinating Committee protocols and guidelines, http://www.nationalwind.org/publications/wildlife.htm and The Developers Perspective, www.abanet.org/ environ/committees/renewable energy) and conservation organizations objectives include:
1. Determine breeding bird densities in and around proposed WRAs
2. Minimum of one season of pre-construction avian use data, more if little relevant regional data available
3. Breeding season raptor nest surveys within 1-mile of site; 2 miles if sensitive raptor species may be present,
4. Habitat mapping and sensitive species surveys.

PRE-CONSTRUCTION STUDY OBJECTIVES

Composite pre-construction study objectives were designed to estimate potential impacts and existing wildlife use. Objectives were:

Objective I. Determine breeding bird densities in MWPP and vicinity (7 km).

A. ferruginous hawks (FEHA) and burrowing owls (BUOW),
B. passerines, shorebirds, & waterfowl.

Objective II. Determine use of MWPP by migrant birds.
A. passerines, shorebirds, & waterfowl,
B. raptors.

Objective III. Determine seasonal use of MWPP by bats.

Objective IV. Investigate mortality of birds and bats around existing wind turbines in the vicinity of MWPP.

Objective V. Determine seasonal big game use in MWPP.

Objective VI. Determine threatened and endangered species use in MWPP.

GENERAL PRE-CONSTRUCTION STUDY METHODS

Biological & Geological References

Standard references and field guides were used to identify wildlife species and assist in evaluation of potential for occurrence of sensitive species. For currently accepted names of wildlife species, Wilson and Ruff (1999) was referred to for mammals; the AOU check-list of North American birds (www.aou.org/checklist/) was referred to for birds; and Stebbins (2003) was referred to for amphibians and reptiles

Montana Natural Resource Information System (www.nris.mt.us) was used for identification of significant geologic features, including the status of Daisy Dean Creek (Fig.1). NRCS web site (www.mt.nrcs.usda.gov) provided information on soils and geology for the project site.

General methods and associated citations designed to address pre-construction study objectives are listed in Table 1. Methodology and timing specifics applicable to MWPP and not explicit in citations include:

Table 1. Methods for pre-construction study of vertebrate wildlife, Martinsdale Wind Resource Area.

Objective	Methods	Citation
I. Breeding Bird Densities		
A. FEHA & BUOW	Raptor nest surveys[1]	Conway & Simon 2003 (BUOW)

		Kerlinger *et al.* 2000
		Lederle *et al.* 2000
	Aerial Search	Fuller & Mosher 1987
		Linehan 2004
B. Passerines, etc.[2]	Point Counts	Fuller & Mosher 1987
		Ralph *et al*. 1993
II. Migrant Birds		
A. Passerines, etc.[2]	Marine Radar	Harmata *et al.* 1999
		Harmata *et al.* 2003
		Harmata 2003
B. Raptors	Raptor Survey Routes	Fuller & Mosher 1987
		Goldstein & Hibbitts 2004
III. Bat Seasonal Use		
Autumn	Marine Radar	Harmata *et al.* 1999
		Harmata *et al.* 2003
		Weller & Zabel 2005
Summer	Acoustic Monitoring	Hill & Greenway 2005
IV. Bird & Bay Mortality	Transects, Spot Searches	Anderson et al. 1999

[1]Includes mostly raptors but passerines of selected species of other Orders (*e.g.*, sandpipers (Charadriiformes)) also.

[2]Includes mostly neotropical migrants but selected other groups also (*e.g.*, waterfowl).

FIELD STUDIES

BREEDING BIRD DENSITY (OBJECTIVE I). Determine breeding bird densities in MWPP and vicinity (7 km).

A. ferruginous hawks (FEHA) and burrowing owls (BUOW),
B. passerines, shorebirds, & waterfowl.

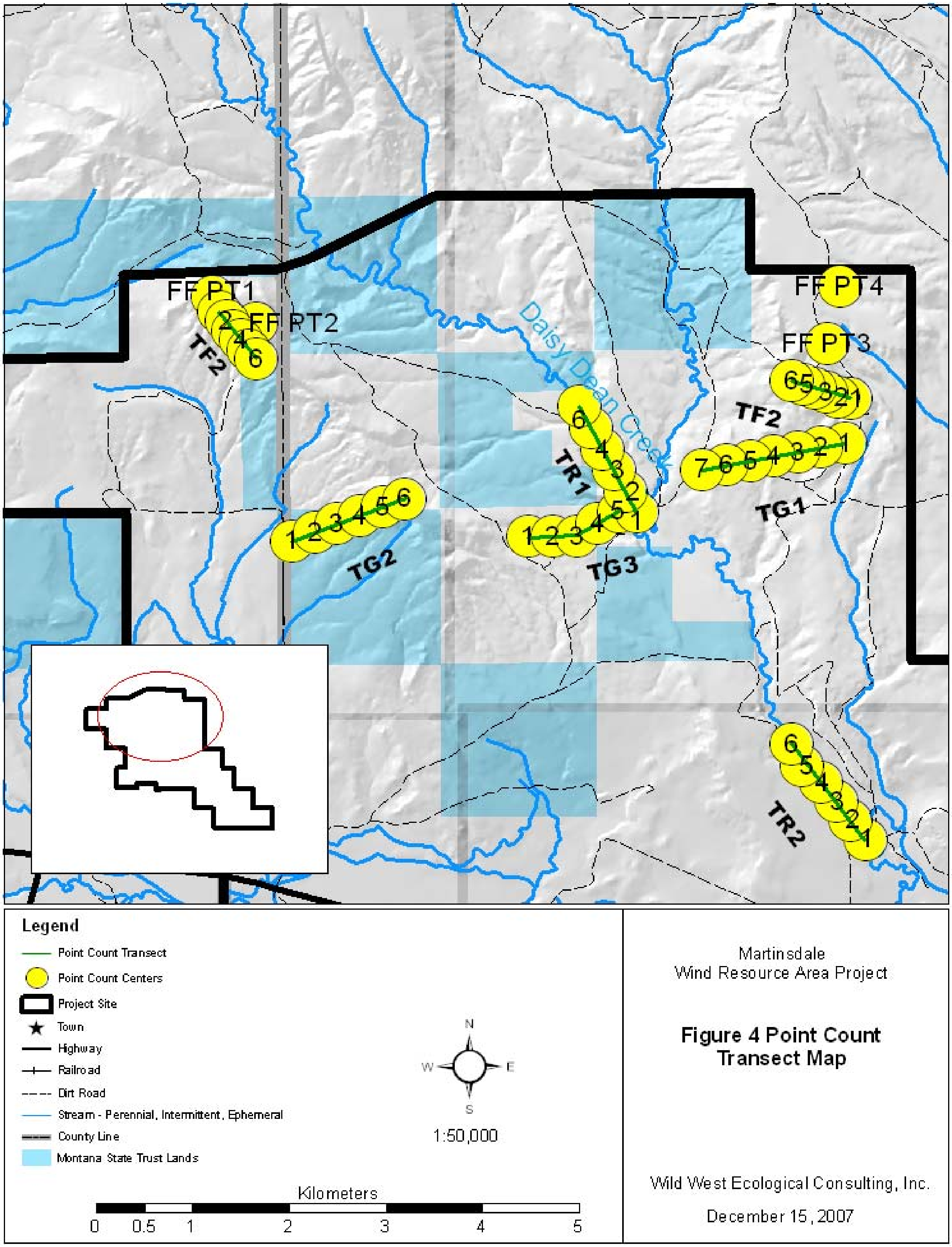
Methods

Seven point count transects were established, three in grassland habitat (#1-3), two in forested habitat (#4-5) and two in riparian habitat (#6-7) (Table 2). Number of transects for each type represent the general frequency of those types over the affected landscape. Each transect was composed of six points, except grassland transect #1 (7 points) and grassland transect #3 (5 points). In grassland and riparian habitats with open visibility transect points were 250 meters apart and utilized a 100 meter scanning radius. In the forested habitat, with reduced sight distance, points were 125 meters apart with a 50 meter scanning radius. At each point all birds seen and heard within the designated radius were recorded during a timed

10 minute period (Hutto et. al 1998). Observations started after the "dawn chorus" subsided (ca. 6:45 AM), and were completed by 10:00 AM.

Table 2. Location and orientation of point count transects, Martinsdale WRA, 2007.

Transect	UTM	Azimuth (Magnetic)
1. Grassland	12T 0561569 5152677	260 degrees
2. Grassland	12T 0555742 5151625	70 degrees
3. Grassland	12T 0558172 5151666	60 degrees
4. Forest	12T 0561726 5153072	290 degrees
5. Forest	12T 0554985 5154114	120 degrees
6. Riparian	12T 0561838 5140480	320 degrees
7. Riparian	12T 0559426 5151853	30 degrees


FF PT1
FF PT2
FF PT4
FF PT3
Daisy Dean Creek
TF2
TR1
TG1
TG2
TG3
TR2
Legend
Point Count Transect
Point Count Centers
Project Site
Town
Highway
Railroad
Dirt Road
Stream - Perennial, Intermittent, Ephemeral
County Line
Montana State Trust Lands
N
W
E
S
1:50,000
Kilometers
0 0.5 1 2 3 4 5
Martinsdale
Wind Resource Area Project
Figure 4 Point Count
Transect Map
Wild West Ecological Consulting, Inc.
December 15, 2007

Results

3 major habitat types are identified within MWPP; forest, native/open grassland, riparian. Two transects in each habitat type were covered twice (12 transects). Transects had 6 Point count locations. Point count locations in native/open grassland and riparian habitat were 250 m apart with 100 m scanning radii. Point count locations in forest habitat were125 m apart with 50 m scanning radii. Point count transects were covered only between 0600 and 1000 hrs MDT and start times were alternated among habitat types and transects.

Initially point count transects were to be replicated at least 30 days apart (Hazlewood et. al 2006). However, the first iteration was conducted May 27 to June 15, and the second iteration from June 2-20. On the forested transects, first and second iterations were only two days apart.

An ongoing list of all species seen on the study area was maintained as well (Appendix I).

Point count transects were conducted from May 27-June 15, 2007, with a second iteration conducted June 4-20. A 30-day spread between iterations was provided in the study plan, but was not followed because of weather. Even though we had overlap, we still provided repetition of the point transects. Consequently, data from both iterations was consolidated in Table 2.

For both iterations combined, 842 individual birds of 41 species, and one unidentified individual were recorded on the point count plots (Table 3). Horned larks, Vesper sparrows, Western meadowlarks and Red-winged blackbirds predominated, together constituting 61% of all birds seen. Bird list in table 3 follows AOU check-list of North American birds (www.aou.org/checklist/). Example VESP is Vesper Sparrow.

Table 3. Species abundance on point count transects, Martinsdale WRA, May-June, 2007.

Species Transect number

	1	**2**	**3**	**4**	**5**	**6**	**7**	**T**
HOLA	48	48	33				1	140
VESP	48	42	28			5	6	129
WEME	42	35	16	12	8	7	6	122
RWBL						64	57	121
BHCO					1	24	19	44
MOCH				21	19			40
CLNU				14	13			27
YEWA						13	10	23
BRBL			11			10	1	22
AMRO					12		6	18

CHSP				8	9			17
COYE						13	4	17
GRCA						8	5	13
WIFL						10	1	11
MOBL				7	4			11
MODO				2	6	1		9
RBNU				5	4			9
PIJA					8			8
EAKI						6	1	7
AMWI						7		7
SOSP						7		7
MALL						6		6
NRSW						6		6
BBMA				3	2			5
SAVS						1	3	4
RECR					3			3
COSN							3	3
CITE						3		3
NOFL				1	2			3
WWPE					2			2
GBHE						2		2
CORA				1	1			2
AMKE				1	1			2
CLSW						2		2
PISI				1				1
CCSP						1		1
LBCU							1	1
NOHA							1	1
EUST				1				1
WBNU					1			1
YRWA					1			1
UNKN							1	1
Total	138	125	88	77	97	196	126	847

Tables 4, 5 and provide frequency of occurrence (proportion of points where present) by habitat type. As well as relative abundance (number seen per point) of species identified, transects in the grassland habitat type represented the greatest abundance of Horned larks, Vesper sparrows and Western meadowlarks. Riparian habitat had the highest number of Red-winged blackbirds and Brown-headed cowbirds.

Grassland transects averaged 9.750 birds per point (Table 3), intermediate of the three habitat types sampled, but this abundance was represented by only for species, by far the lowest species diversity detected on the transects. Forested transects contained 20 species (Table 4) for an intermediate density, but had the lowest density, with only 7.25 birds present per point. Riparian habitats had the highest species diversity with 22 species (Table 5), and also the highest density with 13.417 birds per point.

Table 4. Species, number of points, frequency of occurrence and relative abundance of birds detected on grassland transects, May and June, 2007.

Species	Number of Points	Frequency	Relative Abundance
HOLA	31	0.861	3.583
VESP	33	0.917	3.278
WEME	31	0.861	2.583
BRBL	1	0.028	0.306
All species	36	1.000	9.750

Table 5. Species, number of points, frequency of occurrence and relative abundance of birds detected on forested transects, May and June, 2007.

Species	Number of Points	Frequency	Relative Abundance
MOCH	20	0.833	1.667
CLNU	18	0.750	1.125
WEME	18	0.750	0.833
CHSP	10	0.417	0.708
AMRO	4	0.167	0.500
MOBL	4	0.167	0.458
RBNU	8	0.333	0.375
MODO	7	0.292	0.333
PIJA	3	0.125	0.333
BBMA	4	0.167	0.208
NOFL	3	0.125	0.125
RECR	1	0.042	0.125
CORA	2	0.083	0.083
AMKE	2	0.083	0.083
WWPE	2	0.083	0.083
PISI	1	0.042	0.042
BHCO	1	0.042	0.042

EUST	1	0.042	0.042
YRWA	1	0.042	0.042
WBNU	1	0.042	0.042
All species	24	1.000	7.250

Table 6. Species, number of points, frequency of occurrence and relative abundance of birds detected on forested transects, May and June, 2007.

Species	Number of Points	Frequency	Relative Abundance
RWBL	20	0.833	5.042
BHCO	14	0.583	1.792
YEWA	13	0.542	0.958
COYE	11	0.458	0.708
GRCA	10	0.417	0.542
WEME	8	0.333	0.542
WIFL	7	0.292	0.458
BRBL	4	0.167	0.458
VESP	8	0.333	0.458
EAKI	3	0.125	0.292
AMWI	3	0.125	0.292
SOSP	3	0.125	0.292
NRSW	2	0.083	0.250
MALL	2	0.083	0.250
AMRO	3	0.125	0.250
SAVS	3	0.125	0.167
COSN	3	0.125	0.125
CITE	2	0.083	0.125
GBHE	2	0.083	0.083
CLSW	1	0.042	0.083
MODO	1	0.042	0.042
CCSP	1	0.042	0.042
LBCU	1	0.042	0.042
NOHA	1	0.042	0.042
HOLA	1	0.042	0.042
All species	24	1.000	13.417

Impact Assessment

Structure Collision Potential

The risk of structure collision by resident bird species recorded on the point count transects is slight to moderate. Predominant species include Horned lark, Vesper sparrow, Western meadowlark and Red-winged blackbird. All of these, with the exception of Red-winged blackbirds, are ground-nesting and ground-foraging species that seldom fly at the level of the swept area for wind generators proposed for this site. Furthermore, the Red-winged blackbirds were only found on the riparian transects, a habitat type which occurs at lower elevations, away from the proposed wind turbine generator locations.

Generator placement is planned for ridgetops in either cultivated fields or grassland habitat, surrounded by or in close proximity to forested habitat. Thus, those resident breeding bird species whose flight characteristics and behavior are likely to encounter turbines are most at risk. Those species are listed in Table 7, and include 3.1% of the birds seen on grassland transects and an aggregate of 37.3 % of the birds seen on timbered transects. It's important to recognize that the concept of *at risk* does not equate to mortality because only an unknown portion of those birds, which are *at risk*, would actually encounter a generator.

Table 7. Species judged to be potentially vulnerable to generator collision, habitat type, and percentage of highlighted species relative to all birds in that habitat type based on point count transects.

Species	Habitat	# Points	Frequency	Abundance	% of Birds
BRBL	Grassland	1	0.028	0.306	3.1%
CLNU	Forest	18	0.750	1.125	15.5%
MOBL	Forest	4	0.167	0.458	6.3%
MODO	Forest	7	0.292	0.333	4.6%
PIJA	Forest	3	0.125	0.333	4.6%
BBMA	Forest	4	0.167	0.208	2.9%
NOFL	Forest	3	0.125	0.125	1.7%
RECR	Forest	1	0.042	0.125	1.7%

In summary, the proposed development appears to present little direct hazard to resident breeding birds during the nesting and post-fledging seasons.

Displacement

Placement of wind turbines may cause displacement of breeding birds, resulting in a *de facto* loss of habitat. Leddy et al. (1999) studied CRP lands at Buffalo Ridge WRA, MN, and found that areas without turbines and areas >180 meters from turbines supported higher densities of grassland birds. As a mitigation factor, wind turbine generators should be located on cultivated, crop land where grassland bird density is lower rather than CRP land, whenever feasible.

Leddy et al. (1999) worked with a species composition that was substantially different than that found on the Martinsdale WRA, and there are likely other differences in habitat and climate between the two sites as well. On the Martinsdale WRA relative abundance of all species was highest in riparian habitat, intermediate in forested habitat, and lowest in grassland (Tables 3-6).

Two replications on four plots in cultivated areas provided very few observations of resident birds, only two sightings of Western meadowlarks and four sightings of Horned larks. Hence, impact of displacement on grassland nesting birds would be least (nearly nil) in cultivated areas and greatest in riparian areas. Furthermore, grassland supported the lowest species diversity, and generators in that type would affect fewer species.

Nest Surveys

Methods

Raptor nest searches were completed by air (1 flight), pedestrian, or vehicle means, depending on species involved. The aerial survey covered the area within one mile of all ground disturbing activities, or within two miles if there is a likelihood of sensitive species and identify priority sites for further inspection on foot or by vehicle (*e.g.*, excrement or castings of burrowing owls on mounds). Aerial surveys were done by a pilot and observer in a fixed-wing aircraft (*e.g.*, Cessna 180 with a STOL kit, or 150) flying between 30 and 150 AGL, in a transect fashion or by terrain following, depending on species involved.

Results

A total of eighty-nine nests and forty burrow locations were mapped. The burrow locations represented anywhere from one to seven entrances and only included those that had been dug out and enlarged another species such as a red fox or badger. The burrows mapped represent just a small percentage of the total burrows available on the project site for use by burrowing owls. Ground squirrel hole densities are high throughout the site, especially in the grassland habitat and along exposed banks of the riparian habitat. It is believed that a majority of the medium to large stick nests present on the site were located in those areas surveyed. However, only a small percentage of small stick nests and cavity nests were located.

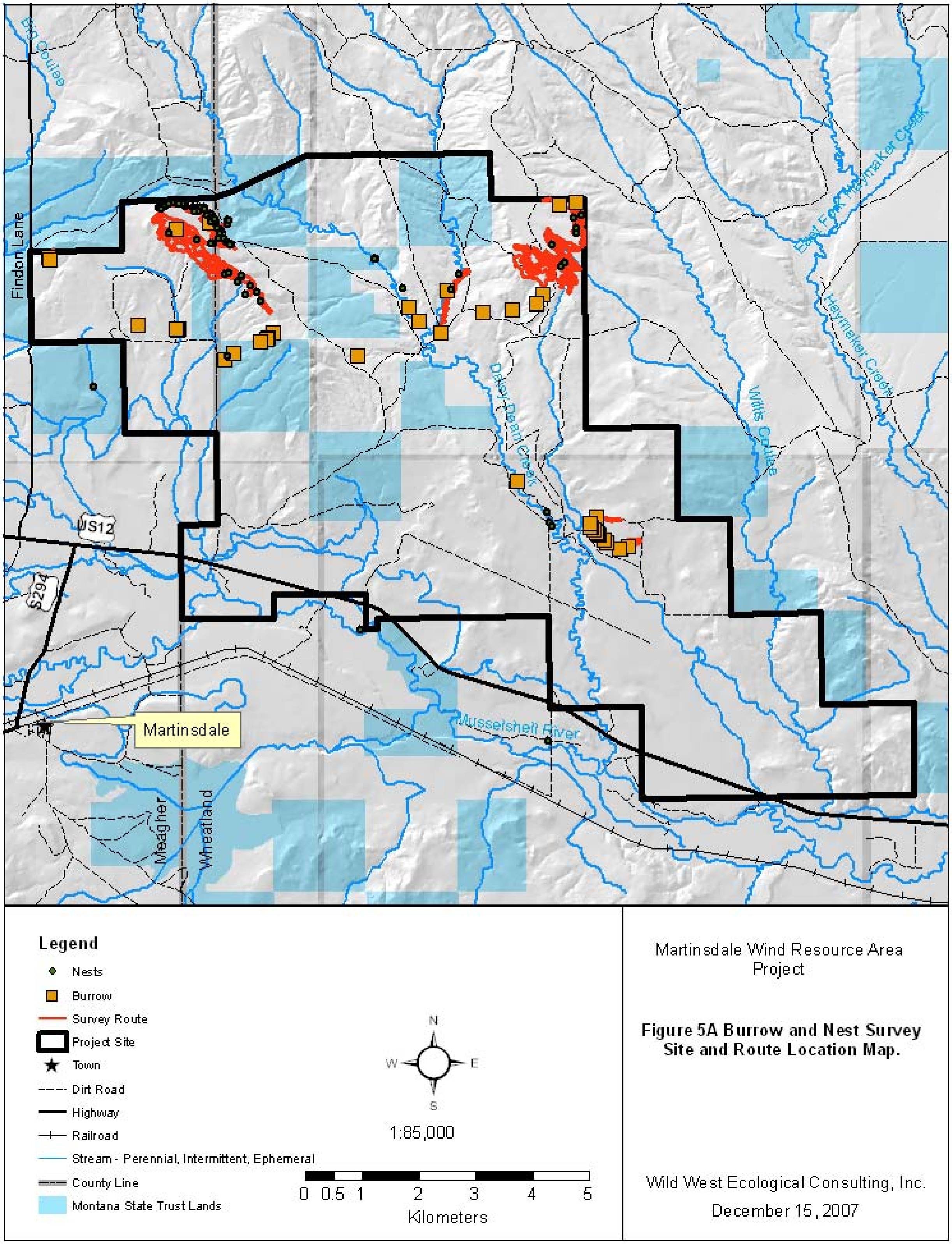
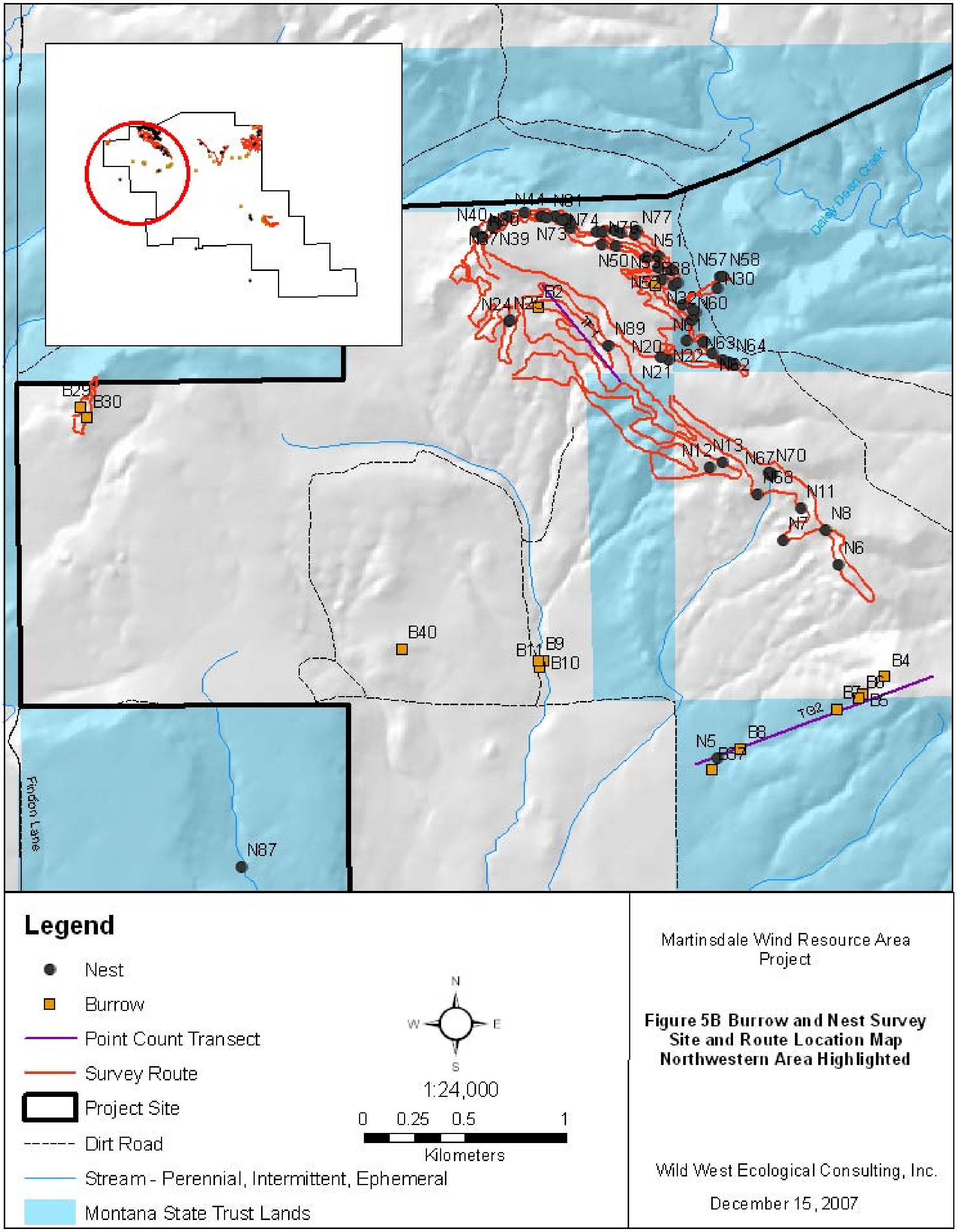


Figure 5A Burrow and Nest Survey Site and Route Location Map.



Martinsdale Wind Resource Area Project

Figure 5B Burrow and Nest Survey Site and Route Location Map Northwestern Area Highlighted

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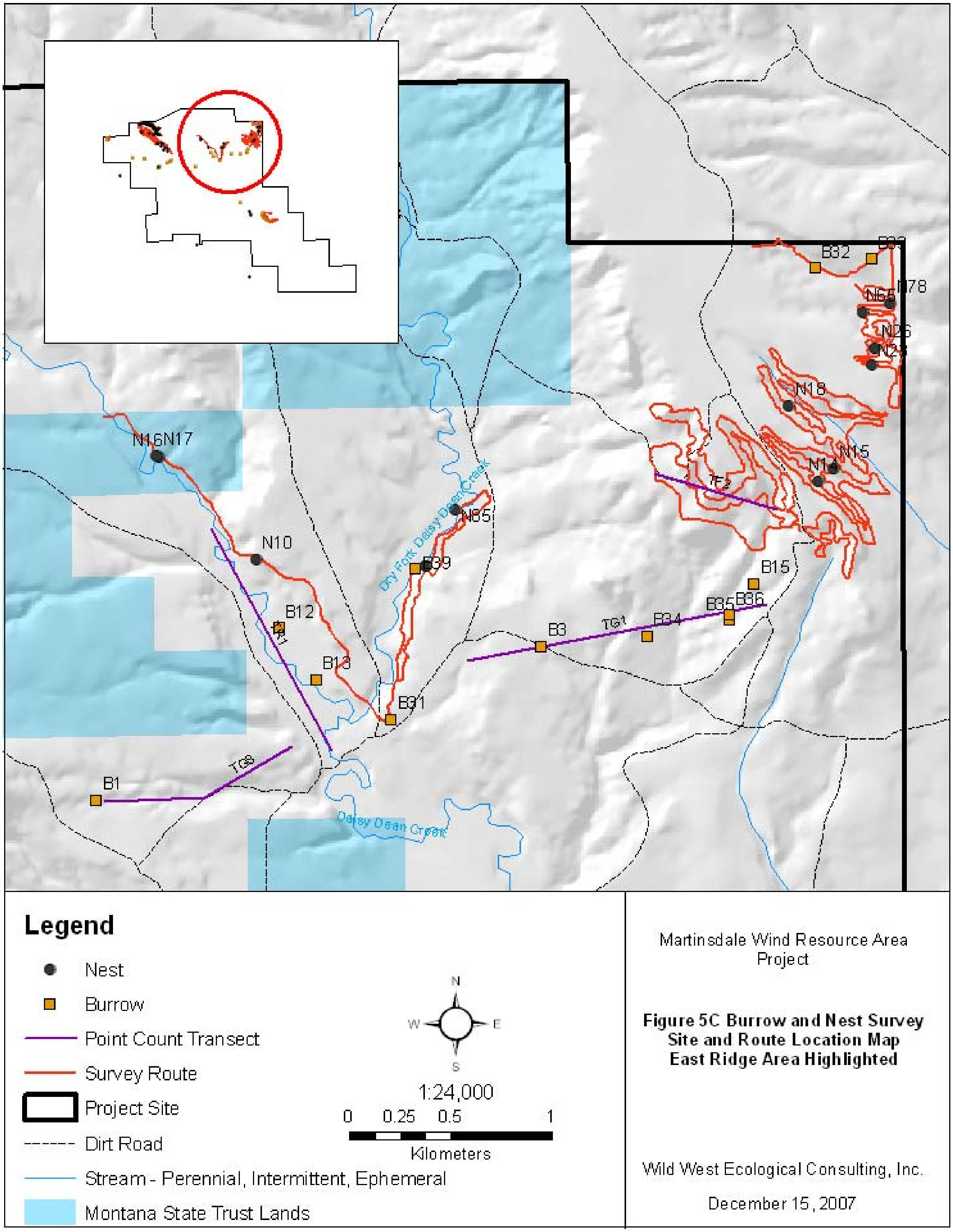
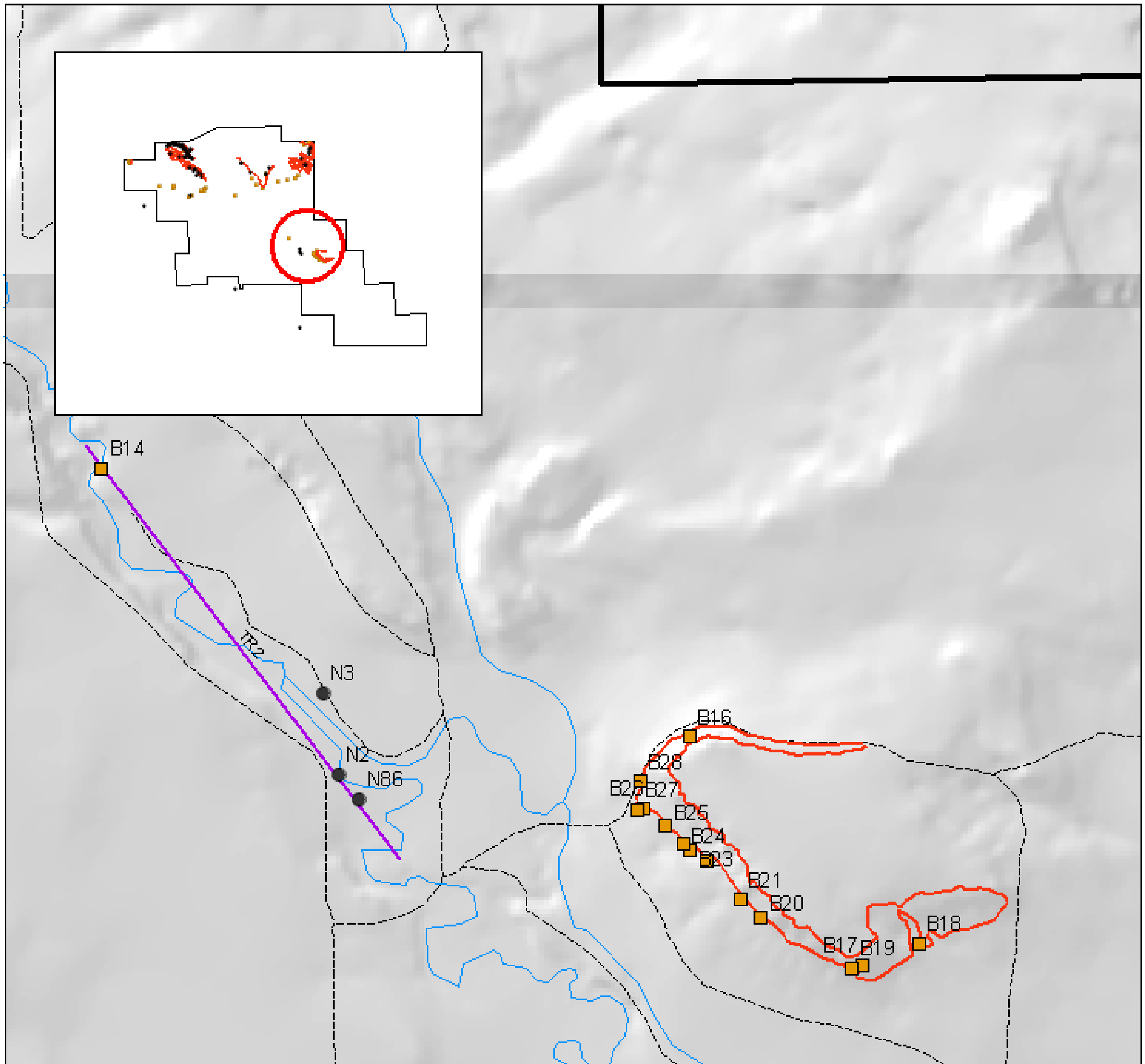


Figure 5C Burrow and Nest Survey Site and Route Location Map East Ridge Area Highlighted



Legend

- Nest
- Burrow
- Point Count Transect
- Survey Route
- Project Site
- Stream - Perennial, Intermittent, Ephemeral
- Montana State Trust Lands

N
W E
S

1:14,000

0 0.25 0.5 1

Kilometers

Martinsdale Wind Resource Area Project

Figure 5D Burrow and Nest Survey Site and Route Location Map Southeastern Area Highlighted

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Nests of significance that were found included two active golden eagle nests, one on the east ridge and one on the west ridge of the project site. The east ridge nest initially had two chicks, but only one survived to fledge. The west ridge nest had only one chick, close to fledging, at the time that it was found. Golden eagle nest location for the East ridge nest N46 31.8816 W110 11.625; West ridge location N46 31.656 W 110 15.907. Golden eagles form breeding territories which are maintained from generation to generation. Within the boundaries of each territory are feeding, roosting, nesting, and soar-playing areas. The size of the territory depends to a large extent upon the availability of food, nest sites, and suitable terrain for flying.

Golden eagles usually have a number of alternate nests, ranging from 1 to 14, although 2 to 3 is the usual number. The same nest may be used by a pair during consecutive nesting seasons, although they often repair alternate nests and visit them regularly until the eggs are laid. Although surveys were conducted, we did not locate any alternate golden eagle nests. Adult eagles are extremely wary when someone comes near the eyrie and in many cases will be gone before the observer is even aware of the nest. The major consequences of human visiting active eyries include: (1) possible desertion by parent eagles of their eggs and young; (2) the increased chance of egg breakage by parent birds, as well as the increased chance of cooling, overheating, loss of humidity, and avian predation of eggs; (3) possible chilling or overheating of the newly hatched birds in the absence of brooding; (4) possible premature fledging by older nestlings resulting in broken bones at the end of a futile first flight or nights spent on the ground where vulnerability to predation is high; (5) possible scent trails guiding predators to the eggs or young; (6) the possible attraction of the attention of other humans (Olendorff, R. and J.W. Stoddart, 1974) .

On the basis of the preceding brief survey of golden eagle requirements and behavior, it appears that current activities and conditions pose no threat to the nesting eagles. The effect of humans, however, can be significant. To minimize potential effects on nesting eagles, the following list of recommendations, pursued voluntarily as part of a wildlife management plan developed and implemented collaboratively by the ranch owner and the Project operator, is offered in the order of their management priority and feasibility.

(1) Eyrie sites should not be made known to the general public. Many people are not aware that golden eagles are protected by law nor do they comprehend the possible consequences of disturbing active nest sites.

(2) Adult eagles can tolerate human activity below the nests but are very intolerant of it above them. Available evidence indicates that golden eagles most frequently and readily desert their nests during the period of incubation. Once the eaglets have hatched, the probability of desertion decreases considerably. Therefore, human activity should be

minimized within a ¼ mile of the known active eyrie sites during the period extending from February 1 to June 1. Alternative nests, if located, should also buffered from human activity.

A ferruginous hawk nest was found during the course of the surveys. Initially it appeared to be inactive, but on a later visit to the vicinity two adult ferruginous hawks were disturbed and observed flying off of the nest area. Upon further inspection it was found that nesting material had been added to the nest since it was first found. However, no eggs or chicks were ever observed in the nest.

Three American kestrel nest cavities were located, however, at one of the nest locations both the male and female were killed, on separate occasions. Only feathers remained near the base of the nest tree. It is not known what killed them, but they appeared to have been preyed upon either for food or territory. It is believed that there are/were several more American kestrel nests on the project site; however the exact location of their cavity nests were never discovered.

The general location of three northern harrier nests along Daisy Dean Creek was found based on bird behavior. A northern goshawk was observed in the area and behaved on two separate occasions as if it had a nest in the vicinity. However, its nest was never located.

Although no burrowing owls or their nests were observed, the project site does provide suitable habitat. A bald eagle had been observed on several occasions at the nearby Martinsdale Reservoir and along the riparian woodlands of the Musselshell River. It is possible that there is a bald eagle nest in the vicinity but not on the MWPP.

Pairs of sandhill cranes were frequently observed dispersed along Daisy Dean Creek. It is almost certain that there were sandhill crane nests dispersed along the creek corridor.

Although a long-billed curlew nest was never located, 4 pairs were observed on a daily basis in the farm fields and grasslands of the project site. Again, it is almost certain that they nested in those habitats as well. A greater sage grouse lek was observed on state lands located on the west side of Findon Road. Eleven male sage grouse were observed displaying on May 17, 2007. No sage grouse were observed on the MWPP. The lek is approximately 3 miles from the north of the proposed wind project boundary.

Sensitive Wildlife Species

A total of 55 sensitive wildlife species were identified that may potentially occur within the BSA. Of the wildlife species identified, there were four amphibian species, 5 reptile species, 33 bird species, and 14 mammal species.

Species were considered to have a high potential for occurrence if the project site was within its known range and suitable habitat was available on-site or if the species was known to occur in the immediate project vicinity. A species was considered to have a low potential to occur if the project site was on the edge of its known range or if within its range, no suitable habitat was known to be available on-site and it was not known to occur in the immediate vicinity.

Table 7. Sensitive Species, Status and Occurrence on MWPP

Scientific Name	Common Name	Federal Status	State Status	Potential to Occur
Amphibians				
Spea bombifrons	plains spadefoot	None	SOC	High
Bufo boreas	western toad	None	SOC	High
Bufo cognatus	Great Plains toad	None	SOC	Low
Rana pipiens	northern leopard frog	None	SOC	High
Reptiles				
Apalone spinifera	spiny softshell	None	SOC	Low
Sceloporus graciosus	common sagebrush lizard	None	SOC	High
Phrynosoma hernandesi	greater short-horned lizard	None	SOC	Low
Heterodon nasicus	western hog-nosed snake	None	SOC	High
Lampropeltis triangulum	milk snake	None	SOC	Low
Birds				
Gavia immer	common loon	None	SOC	High
Pelecanus erythrorhynchos	American white pelican	None	SOC	Present
Nycticorax nycticorax	black-crowned night heron	None	SOC	High
Plegadis chihi	white-faced ibis	None	SOC	High
Accipiter gentilis	northern goshawk	None	SOC	Present
Buteo swainsoni	swainson's hawk	None	SOC	Present
Buteo regalis	ferruginous hawk	None	SOC	Present
Haliaeetus leucocephalus	bald eagle	FDT	SOC	Present
Falco peregrinus anatum	American peregrine falcon	None	SOC	Present
Tympanuchus phasianellus	sharp-tailed grouse	None	SOC	High
Centrocercus urophasianus	greater sage-grouse	None	SOC	Present
Charadrius montanus	mountain plover	None	SOC	High
Numenius americanus	long-billed curlew	None	SOC	Present
Larus pipixcan	franklin's gull	None	SOC	Present
Chlidonias niger	black tern	None	SOC	High
Sterna caspia	caspian tern	None	SOC	High
Sterna hirundo	common tern	None	SOC	Low
Sterna forsteri	Forster's tern	None	SOC	High
Athene cunicularia	burrowing owl	None	SOC	High
Melanerpes lewis	Lewis's woodpecker	None	SOC	High
Contopus cooperi	olive-sided flycatcher	None	SOC	High
Lanius ludovicianus	loggerhead shrike	None	SOC	High
Oreoscoptes montanus	sage thrasher	None	SOC	High
Anthus spragueii	Sprague's pipit	None	SOC	High
Mniotilta varia	black-and-white warbler	None	SOC	High
Spizella breweri	Brewer's sparrow	None	SOC	Present
Calamospiza melanocorys	lark bunting	None	SOC	Present
Ammodramus savannarum	grasshopper sparrow	None	SOC	High
Ammodramus bairdii	Baird's sparrow	None	SOC	High
Calcarius mccownii	McCown's Longspur	None	SOC	Present
Calcarius ornatus	chestnut-collared longspur	None	SOC	High
Dolichonyx oryzivorus	bobolink	None	SOC	Present
Leucosticte tephrocotis	gray-crowned rosy finch	None	SOC	High

Scientific Name	Common Name	Federal Status	State Status	Potential to Occur
Mammals				
Sorex merriami	Merriam's shrew	None	SOC	High
Sorex nanus	dwarf shrew	None	SOC	High
Sorex preblei	Preble's shrew	None	SOC	High
Corynorhinus townsendii townsendii	Townsend's western big-eared bat	None	SOC	High
Lasionycteris noctivagans	silver-haired bat	None	SOC	Present
Lasiurus cinereus	hoary bat	None	SOC	High
Myotis thysanodes	fringed myotis	None	SOC	Present
Euderma maculatum	spotted bat	None	SOC	Present
Canis lupus	gray wolf	FE, XN	SOC	Low
Martes pennanti	fisher	None	SOC	Low
Mustela nigripes	black-footed ferret	FE, XN	SOC	Low
Gulo gulo luscus	North American wolverine	None	SOC	Low
Lynx Canadensis	Canada lynx	FT	SOC	Low
Cynomys ludovicianus	Black-tailed prairie dog	None	SOC	Low

FE and FT indicates federally listed as endangered and threatened, respectively. XE indicates a nonessential experimental population. FDT indicates Federally Delisted Threatened Species. FSC indicates a federal species of concern – no legal protections. SOC indicates a Montana Species of Concern.

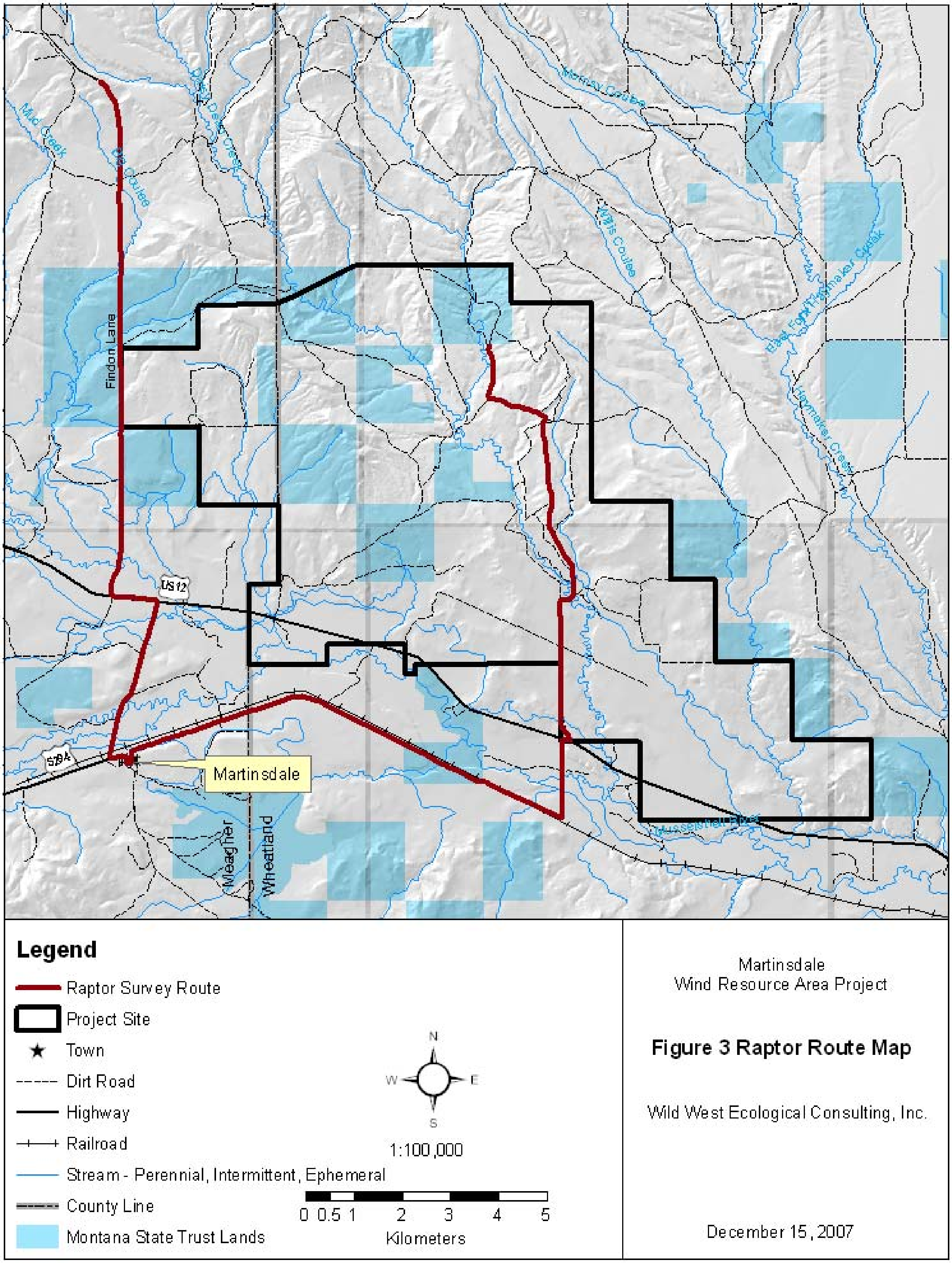
USE OF MWPP BY MIGRANT BIRDS (OBJECTIVE II)

Methods

Raptor distribution and species composition was monitored through use of a roadside raptor survey route that flanked the west, south and east sides of the study area. Raptor occurrence was recorded by species and quadrant. The route was surveyed 27 times, with average length of the route 27.88 miles in length. Observation techniques followed those established by Flath (1978) for the Montana statewide Raptor Survey Route system. Raptor observations were segregated by season into vernal migration, breeding, post-fledging, and autumnal migration. The route was surveyed 27 times, with single observers at a speed of 20-25 mph, using 10x40 binoculars, stopping only to identify raptors. Average route length of 23.88 miles.

Results

Raptor observations were segregated by season into spring migration (Table 1), breeding (Table 2), post-fledging (Table 3) and fall migration (Table 4). During spring migration, an average of .266 raptors were counted per mile of route (Table 1). Golden eagles were the most abundant, at .092 per mile, and accounted for 35% of the raptors seen. Red-tailed hawks were second in abundance. During the breeding season, the number of raptors counted on the route remained essentially unchanged at .264 per mile of route (Table 2).


Mud Creek
Findon Lane
Haymaker Creek
US 12
S294
Martinsdale
Meagher
Wheatland
Legend
Raptor Survey Route
Project Site
Town
Dirt Road
Highway
Railroad
Stream - Perennial, Intermittent, Ephemeral
County Line
Montana State Trust Lands
N
W
E
S
1:100,000
0 0.5 1 2 3 4 5
Kilometers
Martinsdale
Wind Resource Area Project
Figure 3 Raptor Route Map
Wild West Ecological Consulting, Inc.
December 15, 2007

Red-tailed hawks, golden eagles and American kestrels were present in nearly equal numbers. Spring migration appears to accommodate a few more golden eagles than the number seen during the breeding season, but the magnitude of change between the seasons (.092 down to .070) (cf. Tables 1 & 2), does not indicate any major spring migration phenomena. Red-tailed hawks remained stable between these two periods, while American kestrels increased dramatically, from .010 per mile to .066 per mile. This level of increase suggests the study area was a destination for this species, rather than serving as a migration route.

During the post-fledging stage, distribution of raptors often changes dramatically, and some species will wander widely. Adults are no longer obligated to tend a nest site, and fledged young are free to wander once they are capable of independent flight. Young will often follow adults and food-beg, but gradually become capable of securing food on their own. Some species congregate on pre-migratory staging areas, and thus manifest a local influx. During the post-fledging stage, a raptor survey route is a valuable tool for assessing changes in use on the study area. However, caution should be exercised in interpretation of the data because local retention of fledged young will cause an increase in density, and may not always represent a local influx.

On the Martinsdale WRA, the number of raptors seen on the route increased by 80% from the breeding season to the post-fledging season (Table 3). Golden eagles decreased, suggesting some of them were going elsewhere during this stage. Red-tailed hawks increased only slightly, while Northern harriers and American kestrels increased noticeably. Most of the post-fledging increase can be attributed to American kestrels, which represented 43% of all raptor observations at this time (Table 3). Kestrels typically produce 3-5 eggs per nest (Baicich and Harrison 1997). Depending on weather patters and food availability, this level of productivity would likely result in 2-4 young per successful nest. Not all nests are successful, indicating the number of kestrels seen during this stage included a modest influx from other areas.

Fall migration counts (Table 4) showed a decline or stability, except in the case of turkey vultures. Yet, number of raptors per mile was slightly higher than either spring migration or breeding season. Two events could account for this trend: either kestrels were reluctant to leave the area in fall, or the area serves as a minor fall migration route.

Aggregate raptor occurrence during the study period (Table 5) reveals that 37% of all raptor observation took place in the northeastern quadrant. This is the area of the “east butte” and adjacent habitat. Hence, wind turbine generators located in the easternmost sections of the MWPP would likely constitute the greatest relative potential hazard to raptors.

Table 1. Raptor survey route data by quadrant and species, four iterations during spring migration, February 21 – April 13, 2007, 97.8 route miles.

Species	**SE**	**NE**	**NW**	**SW**	**Total**	**#/mile**
TUVU			1	1	2	.020
GOEA	4	1	4		9(35%)	.092
BAEA	1		1		2	.020
NOHA	1	1		2	4	.041
RTHA	2	1	1	3	7	.072
FEHA		1			1	.010
AMKE			1		1	.010
Total	8	4	8	6	26	.266

Table 2. Raptor survey route data by quadrant and species, eleven iterations during breeding season, April 21 – June 21, 2007, 272.9 route miles.

Species	**SE**	**NE**	**NW**	**SW**	**Total**	**#/mile**
GOEA		7	12		19	.070
NOHA	1	5	3	2	11	.040
RTHA	5	1	3	11	20	.073
FEHA		1	2		3	.011
AMKE	4	3	10	1	18	.066
PRFA			1		1	.004
Total	10	17	31	14	72	.264

Table 3. Raptor survey route data by quadrant and species, five iterations during post-fledging season, August 13 – September 12, 2007, 126.5 route miles.

Species	**SE**	**NE**	**NW**	**SW**	**Total**	**#/mile**
TUVU	1				1	.008
GOEA		2	2		4	.032
NOHA	6	6	1	1	14	.111
RTHA	5	1	5		11	.087
SWHA	2				2	.016
AMKE	1	21	3	1	26(43%)	.206
MERL		1			1	.008
PEFA	1				1	.008
Total	16	31(52%)	11	2	60	.474

Table 4. Raptor survey route data by quadrant and species, seven iterations during fall migration, September 17 – November 15, 2007, 148.2 route miles.

Species	SE	NE	NW	SW	Total	#/mile
TUVU	2	1		1	4	.027
GOEA	2		1		3	.020
BAEA	3				3	.020
NOHA	1		3	2	6	.040
RTHA	3	1	1	3	8	.054
AMKE	3	14	2	2	21	.142
PRFA	1			1	2	.013
Total	15	16(34%)	7	9	47	.317

Table 5. Raptor survey route data by quadrant and species, twenty-seven iterations during entire survey period, February 12 – November 15, 2007, 644.7 route miles.

Species	SE	NE	NW	SW	Total	#/mile
TUVU	3	1	1	1	6	.009
GOEA	6	10	19		35	.054
BAEA	4		1		5	.008
NOHA	10	12	7	3	32	.050
RTHA	24	4	10	3	41	.064
SWHA	2				2	.003
FEHA		2	2		4	.006
AMKE	8	29	16	3	56	.087
MERL		1			1	.002
PRFA	1		1	1	3	.005
PEFA	1				1	.002
Total	50	68(37%)	57	11	186	.289

Impact Assessment

Number of raptors seen per mile of route can be used to compare abundance between seasons as well as changes in species composition. Of particular interest is the potential event of a post-fledging influx when young raptors leave the nest. Some species may wander widely at this time, and a given area may manifest either an influx or an out flux, or may remain essentially stable. During the post-fledging stage, distribution of raptors often changes dramatically, and some species will wander widely. Adults are no longer obligated to tend a nest site, and fledged young are free to wander once they are capable of independent flight. Young will often follow adults and food-beg, but gradually become capable of securing food on their own. Some species congregate on pre-migratory staging areas, and thus manifest a local influx. During the post-fledging stage, a raptor survey route is a valuable tool for assessing changes in use on the study area. However, caution should be exercised in interpretation of the data because local retention of fledged young will cause an increase in density, and may not always represent a local influx.

Not all species of raptors are equally vulnerable to collision with wind turbines. Most vulnerable are golden eagles, red-tailed hawks and American kestrels. Resident breeding adults are generally very familiar with their home range, and wary of features within that area. Hence, the lowest risk can be assigned to the resident adults. Fledged young, unfamiliar with local topography and landscape features, are relatively naïve, and far more subject to generator collision. Golden eagles declined from the breeding season to the post-fledging stage, and declined further during fall migration. Red-tailed hawks increased 19% from breeding to post-fledging then declined during fall migration. American kestrels increased substantially during post-fledging and showed only a modest decline in occurrence during fall migration. Many of these were likely hatch-year birds, vulnerable to impacts. Thirty-seven percent of all raptors counted were recorded in the northeastern quadrant. This quadrant also accounted for 52% of the kestrel observations. Hence, the greatest risk to raptors from the proposed development may occur on the east and west buttes near the Ponderosa pine timbered areas which includes the northeastern quadrant.

OBJECTIVE III. Determine seasonal use of MWPP by bats.

Introduction

Because most birds (other than raptors) migrate at night and bats are almost exclusively nocturnal, visual methods of detecting migrating birds and bats are ineffective. Portable marine surveillance radars (MSRs), seen commonly on small private and commercial watercraft, have been employed successfully to record aerial vertebrate activity over proposed and existing wind developments. A drawback of MSRs is the inability to distinguish between birds and bats. The preferred technique for detecting and distinguishing birds from bats is infrared thermal imaging (Kunz *et al.* 2003) and some estimates indicate a system may be employed for as low as $15,000 (Energetics 2004). However, radar may be the most cost effective technique here, mostly because surveillance will be of a reconnaissance nature rather than for an impact study and equipment and expertise are already available. Accordingly, MSR will be monitored in alternating vertical mode (to detect height (y-coord.) of aerial vertebrates) and horizontal mode (to detect distance and location (x & y cords) of aerial vertebrates) only between sunset and 2400 hrs once weekly during the surveillance periods (Fig. 2). Focus on migrant birds will be in spring and autumn and focus on bats primarily in autumn.

Bat echolocation monitoring using ultrasound detection equipment (e.g., bat detectors) (Reynolds 2006, Johnson et al. 2004), thermal infrared (TIR) cameras (Horn and Arnett 2005) and marine surveillance radar (Harmata et al. 1999, 2000) have been used to detect bird or bat activity at proposed or existing wind farms. Each technique has limitations inhibiting its value for evaluation of bat use of large areas. The techniques of bat detection are of minimal value for migrants but may be of some benefit for evaluating use of MWPP by bats in summer. Acoustic monitors may allow location of foraging locations but minimal range of # 130 m limits their effectiveness but will be employed. In concert with MSR, thermal imaging and acoustic surveillance will provide a profile of bat use of selected areas of MWPP in summer and fall.

Bat detectors have very short ranges (tens of meters) and only can detect presence of certain bat species, not location (Forsman 2001, Adams 2003). TIR cameras permit operators to distinguish between birds and bats but also have short range and cannot quantify location unless in reference to known structures. Marine radar has extended range capability (> 2.7 km), capabilities to quantify height and location, but cannot discriminate among insects, birds, and bats. Gauthreaux and Livingston (2006) employed both radar and a TIR camera to differentiate between birds and bats. However, applicability of similar “fixed beam” systems for determining use of proposed wind farms by birds and bats may not be adequate because surveillance area is fixed and relatively small[1]. Many bird species (and possibly bats) follow narrow migration corridors and concentrated topographical lead lines during migration (Williams *et al.* 2001, Mabee and Cooper 2004, Cryan In Press). Between 31 May and 2 June, and 30 August and 2 September 2007 we conducted tests to integrate bat detectors, TIR camera monitoring, and marine surveillance radar in an attempt to more adequately detect bat use of a proposed MWPP more completely than each technique used in isolation.

Objectives

1. Determine if a portable TIR camera could be easily and efficiently employed as a technique for detecting bats (and birds) over the proposed development area,

[1] Fixed systems monitor and area of less than 130 m^2 (1400 ft^2) at a maximum sweep height (120 m or 393 ft) of proposed wind turbines.

2. Determine if characteristics of radar targets could be identified to distinguish between birds and bats on screen, when compared with simultaneous TIR camera images,
3. Determine if both systems and bat detectors produce a more representative picture of bat (or bird) activity over MWPP to evaluate risk or; if either alone, or a combination of two techniques were appropriate.

Equipment

Bat detectors were Pettersson Model D 230 and Model D 240x (www.batsound.com). Frequency range was 10-120 kHz. Bioacoustic ultrasound emissions of all native bat species are in this range (Adams 2003). Display accuracy was $\pm$ 0.15 kHz. Units can be operated in either a frequency division mode or heterodyne mode, while the 240x also has time expansion capability. In frequency division mode, 10 kHz bandwidths are scanned (e.g., if set at 30 kHz, 25-35 kHz is monitored). In heterodyne mode, all frequencies are scanned simultaneously, but sensitivity is reduced. Time expansion preserves all characteristics of the original emission, permitting analysis sound characteristics. Power is supplied by a 9v battery with a life of 25 hrs.

The D 240x was connected directly to a laptop computer by a sound jack. SonoBat software (www.sonobat.com) to record and analyze bat calls. Sonobat software provides a full spectrum analysis of bat calls, permitting more accurate species identification based echolocation emission profiles.

TIR camera was a hand-portable FLIR Systems ThermaCAM® P65HS infrared and thermal imaging system (http://www.Flirthermography.com). Thermal field of view and minimum focus distance were 19° x 14° and 0.3 m, respectively, with spatial resolution (IFOV) of 1.1 mrad. Thermal sensitivity @ 50/60Hz was 50 mK at 30° C (86° F) with detectable thermal range of 0° C to +250° C (+32° F to 482° F). The system had an electronic zoom function, automatic focus, and enhanced digital imager. Spectral range was 7.5 to 13 µm. Visual lens was standard with a 2X telescopic 12^{o} wide-angle add-on lens. Full color digital video (640 x 480 pixels) for data recording was built-in. File format for THERMAL video recording was standard JPEG; 14 bit thermal measurement data included. File format for VISUAL was standard JPEG linked with corresponding thermal image. Battery was Li-Ion, rechargeable, field-replaceable with an operating time of 2 hours continuous operation.

Radar was an X-band, 10 KW Raytheon™ 1210XX described by Harmata *et al*. (2003). External components of the radar system were mounted in the bed of a pick up truck to permit both vertical and horizontal monitoring, but not simultaneously (Harmata *et al*. 2003). Power was delivered by a 12V deep cycle RV battery. The unit was adapted to exploit the vehicle battery if the main battery failed. Range discrimination of the Raytheon 1210 XX is

< 20 m and bearing accuracy is ± 1^{o} at maximum surveillance range (72 nautical miles (nm))(Raytheon Marine Company 1995). A Cyclops hand-held 15 x 10^{5}-candle power portable searchlight was used to visually scan for targets detected by bat detectors and radar.

Methods

Monitoring was conducted on 31 May and 1 June and to investigate bat (and bird) activity during the vernal migration or summer residence period. Monitoring was conducted on 30 August, 2 September, and 3 September to investigate bat (and bird) activity during the autumn migration period.

On site, bat echolocation detectors were set in heterodyne mode to detect presence of bats, then switched to frequency division mode to zero in on frequency (species) by adjusting frequency until " null", with the audible tone ascending on either side. Null indicated true frequency.

Surveillance range of radar was switched among 0.75 nautical miles (nm)(1.4 km), 0.5 nm (0.9 km), 0.25 nm (0.5 km), and 0.125 nm (0.23 km) to maximize sensitivity to small targets. Both horizontal and vertical modes were employed. Areas scanned were 5.3 km^2, 2.5 km^2, and 0.8 km^2 around radar in horizontal mode, and 2.7 km^2, 1.3 km^2, and 0.4 km^2 left, right, and above radar in vertical mode at respective range settings.

As visual scanning or audio returns detected bats, TIR and radar operators were alerted to approximate distance, direction, and height of bats directly or via two-way radio. TIR camera operator attempted to acquire the target on screen and radar operator searched for targets with unique characteristics that could identify them as bats (or birds).

Combined bat detector and radar monitoring were initially tested on the crest of a bluff on the north slope of west butte proposed for turbine placement (Fig.1). Surveillance began approximately ½ hour before sunset. No systematic scanning or surveillance was attempted but both detection devices were monitored continuously and adjusted to maximize sensitivity for audio returns and small targets on screen. The hand-held searchlight beam was directed toward the height and direction of coordinates displayed on the radar screen in an attempt to identify radar echoes visually. The following evening, all three detection techniques were employed. Bat detectors and TIR camera were located in the flood plain of Daisy Dean Creek, approximately 8 m from the flowing creek (Fig. 1).

We used Daisy Dean Creek as a reference site only even though no turbines are proposed to be located by the creek. Radar was monitored on the opposite side of the flood plain 266 m from the bat detectors and TIR camera, but from a higher elevation to reduce ground returns (clutter) on screen. Bats were assumed to frequent the area because of open water (for hydrating) and conditions promoting large flying insect populations. After bat activity subsided near the creek, monitoring returned to the initial site on the west butte.

Birds were differentiated from bats on thermal images by the Thermographer using the following criteria:

1. Flight pattern - flight pattern of bats was erratic and not uniform, while the flight pattern of birds was straight with very little deviation in direction.
2. Thermal Signature - Thermal signature of birds showed a thermal trail behind but appeared to be dependent on size. Bats had a much smaller thermal signature and in the majority of the sightings there were no thermal trails behind the bat signatures.
3. Wing Beat - identified a more rapid wing beat on some of the signatures. When integrated with 1 & 2 above, further indicated bats.

Results

Spring - Acoustic, radar and TIR monitoring was conducted for 8.5 hrs over two days (Table x). On May 31, 2007 combined bat detector and radar monitoring were initially tested on the crest of a bluff on the north slope of the west butte proposed for turbine placement. Surveillance began approximately one half hour before sunset. No systematic scanning or surveillance was attempted, but both detection devices were monitored continuously and adjusted to maximize sensitivity for echolocation returns and small targets on screen.

Table 6. Integrated acoustic, thermal infrared camera and radar monitoring effort for bats and birds and TIR detections, Martinsdale Wind Resource Area, 2007.

	Monitoring			Possible		Detections/Hr	
Date	Span	Hours	Detections	Birds	Bats[1]	Birds	Bats
31 May	2030 - 0030	4.0	0	Unk	0	-	0
1 June	2000 - 0030	4.5	20	Unk (3)	6 (3)	-	1.3
30 August	1933 - 2258	3.5	76	20 (5)	48 (1)	5.7	16.6
2 September	2110 - 2301	1.85	246	46	177	24.9	95.7
3 September	2005 - 2311	3.1	125	26 (1)	78	8.4	25.2

[1]Number in parentheses indicates number confirmed visually or acoustically

No bat echolocations were detected on the west butte during monitoring the first evening. Radar surveillance in the scanning (horizontal mode) produced excessive ground clutter on screen (Fig. 2), even with a modified ground clutter reduction shield installed (Cooper *et al.* 1991). Although targets were detected, excessive ground clutter prohibited adequate interpretation of species or amount of use over the actual wind site, although most appeared to be moving with wind direction (NE – SW). In vertical mode, small targets began appearing about 2130 hrs (Fig. 3). Visual identification by searchlight indicated most if not all targets were moths, most likely Miller's army cutworm moths (*Euxoa auxiliaries*) moving with the wind. As monitoring progressed, height of moths increased to nearly 1000 m agl but abruptly disappeared at approximately 2230 hrs. No evidence of bat presence was detected.

Bat detectors, TIR camera, and radar monitoring the second night near Daisy Dean Creek revealed bats. First detected by bat detectors and confirmed visually, TIR camera images were eventually produced (Figs. 4 & 5). Radar targets were detected in vertical mode (Figs. 6 & 7) coincident with and in the approximate location as those detected by bat detectors, visual scanning, and TIR camera images.

After returning to the west butte, moths again were detected by radar and searchlight but not by TIR camera. Bat detectors, TIR camera, radar, and visual monitoring did not detect bats or birds.

Autumn - Acoustic, radar and TIR monitoring was conducted for 8.45 over three days during the autumn migration period (Table x). On June 1, bat detectors and TIR camera were located in the flood plain of Daisy Dean Creek, approximately 8 m from the flowing creek. Radar was monitored on the opposite side of the flood plain 266 m from the bat detectors and TIR camera, but from a higher elevation to reduce ground returns (clutter) on screen Bats were assumed to frequent the area because of open water (for hydrating) and conditions promoting large flying insect populations. After bat activity subsided near the creek, monitoring returned to the initial project site on the west butte. On September 2 and 3, 2007, all three detection techniques were used on the west butte at Survey Points 1, 2, and 3; and additionally on September 3, near Daisy Dean Creek at Survey Points 6 and 7.

Bat echolocations and TIR images (Fig. X) were detected on the west butte during monitoring the first evening (30 August; Table x). Radar surveillance in the scanning (horizontal mode) again produced excessive ground clutter on screen and was eliminated from further consideration. Virtually all subsequent monitoring was in vertical mode.

Mean percent of TIR detections that could not be identified (Table X) was 12.2% (N =3, SE = 0.023). Bats composed the highest proportion (0.75, N =3, SE = 0.025) of detections for which identity was assigned from TIR images. Proportion of birds and bats identified was not different among nights (Π^2 = 2.481, 2 df, P = 0.289). However, number of both birds and bats detected was different among three nights (Table X) with more detected on 2 September than other nights (Bonferroni Z = 2.777, P < 0.05). No trend in number of bat or bird detections with diel time was evident.

Discussion

Feasibility testing of the three survey techniques was one of the objectives of the study. Study design and implementation effort were sufficient to reveal problems and limitations with the techniques employed but insufficient to provide quantitative data for statistical analysis and comparison. Monitoring with bat detectors can confirm presence and determine bat species but short surveillance range limits utility for evaluation of bat use of a WRA, preconstruction. The bat detectors employed here can detect radar pings at slightly over 100 meters, but many bats do not emit a call loud enough to be detected over 30 meters. Most bats are adapted to using echolocation to detect prey species only at distances of up to 5 meters (Kunz 2004).

Small or distant targets (*i.e.*, dots: Figs. 4 & 5) must be followed to determine flight paths or character (*i.e.*, zigzag flight [see Gauthreaux and Livingston (2006)] to confirm identity with thermal imaging. TIR imaging can and did confirm bat presence at ranges greater than those provided by bat detectors but were not of sufficient detail to indicate species. Without estimates of size, mass, and configuration associated with bat (or bird or insect) species, distance of targets detected in the Field of View (FOV) of the TIR camera generally could not be accurately determined. Evaluation of risk preconstruction is thus limited to presence/absence (as are acoustic results) without distance (height) estimates.

Target fields displayed by TIR will not be confounded by insect clouds as would radar because cold-blooded insects emit little or no thermal energy. However, difficulty of acquiring targets over large areas and relatively small field of view also reduces its effectiveness in preconstruction use/risk assessment studies.

Marine Surveillance Radar can scan large areas (entire WRA) but target identification is problematic. Distinguishing among birds, bats, and bugs is not possible for most small targets. Only waterfowl displayed distinctive signature permitting identification. Targets detected that most certainly were bats (Figs. 6 & 7) displayed no distinctive characteristics on screen that would confirm their identity as bats, even when TIR imaging and acoustic returns indicated bat presence consistent with radar target locations. Bat flight paths are known to be erratic but these characteristics were not immediately evident. Relatively slow RPM of radar eliminated the ability to detect zig-zag flight associated with bats. Our data suggests that unless confirmed visually (searchlight or TIR camera), radar alone is of minimum utility in determining bat use of wind areas.

The Class (*i.e.*, Aves, Mammalia, Insecta) of most targets detected by radar and TIR imaging could not be confirmed. Notable exceptions were detections of geese both visually and with TIR (Figs. X & XX) and common nighthawks visually and by TIR. Bird detections were occasionally obvious as associated thermal flight paths were relatively large and straight. Other than primarily low altitude flight, no unique characteristics could be discerned that would indicate targets were bats or birds. However, thermal trails were not evident on confirmed thermal images of bats as they were for birds and may aid in identification.

Bat & Bird Use of MWPP

Larger number of bats detected over birds may indicate bats use MWPP more than birds during migration. However, other studies have found birds migrate at heights beyond the detection limits of the TIR camera and detections may represent only local or resident movements. Highest number of detections of both birds and bats were recorded in early September and may be representative of near peak of movement. However, making such assumptions based on limited survey nights is difficult.

Detections of possible bats per hour suggest bat activity was low in summer, possibly indicating use of higher portions of MWPP was minimal and activity focused on riparian areas at low elevation. Detections of possible bats per hour increased nearly 100 fold in autumn, suggesting bats were indeed migrating through MWPP and vicinity but magnitude and species composition of migration is unknown.

Recommendations

A combination of systematic radar surveillance in vertical mode, bat detector monitoring along with TIR imaging and employing searchlights may be an effective strategy **–** ***if*** precise turbine design, placement, and operational modes are known. Only then will monitoring be appropriately sited for maximum data return. However, most bat mortality associated with wind turbines is recorded when *lasiurine* bats, such as the hoary bat (*Lasiurus cinereus*) and silver-haired bat (*Lasionycteris noctivagans*) migrate from mid-July to the end of September, with most mortalities occurring in August (Johnson *et al.* 2004). Monitoring conducted when migrating bats are most likely to be present (July/August: Cryan 2003, early Sept.: this study) will be most valuable for evaluating efficacy of TIR imaging for preconstruction impact risk assessment. Additionally, Cryan and Brown (In Press) found “relatively low wind speeds, low moon illumination, and relatively high degrees of cloud cover were important predictors of (hoary) bat arrivals and departures, and that low barometric pressure was an additional variable that helped predict arrivals”. The ability to react to these conditions for monitoring migrant bat activity in autumn may promote more efficient use of resources and produce more representative results. However, a more recent hypothesis suggests wind turbines actually attract hoary bats during migration (Cryan 2007) and lack of preconstruction detection and use may be not be representative of post-construction risk. In general, bat mortality has not been high at western wind project sites and at nearby locations within Montana compared to those studied in forested areas of northeastern states cited above.

BAT ECHOLOCATION SURVEYS

Methods

In addition to attempts to attain bat echolocation recordings mentioned in Section 5.4 above, attempts were also made on September 5, 8, 9, 10, and 11, 2007 at Survey Points 8 through 13 (Figure 13). Survey Point 8 was located in the town of Martinsdale, in a yard area next to the Crazy Mountain Inn where bats had been observed flying on numerous occasions. Survey Points 9 and 10 were along the South Fork of the Musselshell River in riparian woodland habitat. Survey Point 11 was along the North Fork of the Musselshell River, at the bridge crossing near Bair Ranch headquarters. Survey Point 12 was along Spring Creek, near the mouth of the canyon and below rock cliffs. Survey Point 13 was at Clear View Ranch in the yard where there were lights and irrigated lawn.

Bat echolocations were detected using a Pettersson Model D 240x (www.batsound.com) bat detector with a frequency range of 10-120 kHz. Echolocations were recorded directly to a Dell Inspiron E1505 laptop computer through a sound jack. Echolocations were collected as full-spectrum time expansion data. Sonobat software (www.sonobat.com) was used to analyze bat echolocations for species identification, using known species call patterns for comparison.

Many bat echolocations are difficult to identify to species and thus analysis can be very time consuming, therefore species identification was not made for all echolocation recordings. Instead, echolocations that offered the highest potential for an accurate identification or new species identifications were targeted for analysis.

Results

Based on literature and database reviews, including range maps, the following bat species may potentially occur within MWPP: pallid bat (*Antrozous pallidus*), big brown bat (*Eptesicus fuscus)*, spotted bat (*Euderma maculatum*), silver-haired bat (*Lasionycteris noctivagans*), hoary bat (*Lasiurus cinereus*), western small-footed bat (*Myotis ciliolabrum*), western long-eared bat (*M. evotis*), little brown bat (*M. lucifugus*), fringed bat (*M. thysanodes*), long-legged bat (*M. volans*), and Townsend’s big-eared bat (*Corynorhinus townsendii*). Other bat species known to occur in Montana, but are not known to range into MWPP vicinity include eastern red bat (Lasiurus borealis), California bat (*M. caifornicus*), northern bat (*M. septentrionalis*), and Yuma bat (*M. yumanensis*).

A total of 130 echolocation recordings were collected. One recording was collected along the Musselshell River, 15 recordings along Daisy Dean Creek, 84 recordings along Spring Creek, and 30 recordings at Clear View Ranch. More than one bat species was often included in a recording. Bat species recorded on MWPP at Daisy Dean Creek included big brown bat, silver-haired bat, western small-footed bat, and little brown bat. Additional bat species recorded in MWPP vicinity, included California bat, fringed bat, long-legged bat, and spotted bat.

Discussion

Generally, a bat must be in hand before a positive identification to species level can be made. However, advances in bat echolocation analysis, through the use of software (i.e. Sonobat) that utilizes full-spectrum data and a growing library of positively identified bat calls, has allowed for more accurate species identification based solely on echolocations.

All four bat species identified, based on echolocations, at Daisy Dean Creek were species expected to occur in MWPP vicinity. One bat species identified in MWPP vicinity, California bat, was not expected to occur. Remaining three species recorded in MWPP vicinity were expected to occur. Two identified species, fringed bat and spotted bat, are Montana Species of Concern. One identified species, silver-haired bat, is a Potential Montana Species of Concern.

It is anticipated that additional echolocation surveys would also find hoary bat, western long-eared bat, Townsend’s big-eared bat, and pallid bat present in MWPP vicinity. The first three species mentioned tend to fly at heights that make it difficult to obtain echolocations. Pallid bats on the other hand fly close to the ground and tend to feed either on the ground or glean prey off of foliage, making them also difficult to detect with a bat detector.

Collision mortality appears to be most significant for tree-dwelling migratory bat species, based on studies done thus far (Kuvlesky, Jr. et al. 2007). Bat species that utilize hollows, cracks, crevices, and loose bark of trees for roost sites include big brown bat, silver-haired bat, California bat, western long-eared bat, little brown bat, and long-legged bat; while hoary bats will use the foliage of trees as a roost site (Williams et al. 2002).

Little, if anything, is known about the migration habits of most bat species. Pallid bats are believed to over winter in the same area in which they spend the summer. Big brown bat, western long-eared bat, and Townsend’s big-eared bat usually only migrate a short distance in the fall to migrate. Silver-haired bat, hoary bat, and long-legged bat appear to migrate in groups, as might also little brown bat (Williams et al. 2002). There is very little information about the migration habits of spotted bats, California bat, western small-footed bat, fringed bat, or Yuma bat.

Species most likely to be feeding at the height of the blades include big brown bat, spotted bat, silver-haired bat, hoary bat, western long-eared myotis, little brown myotis, and Townsend’s big-eared bat. Of these species, hoary bats may be particularly vulnerable to blade strikes or tower collisions because they are not very maneuverable (Williams et al. 2002). In a review of mortality studies, hoary bats were found to be the most commonly killed species of bat by a large majority (61.7 percent), to a much lesser extent other carcasses identified at wind farms included silver-haired bats, big brown bats, and little brown myotis (Kuvlesky, Jr. et al. 2007). Evidence of hoary bat vulnerability may also be found at Judith Gap where carcasses have been found near turbines (U.S. Fish and Wildlife Service personal communication, 2007).

OBJECTIVE IV. Investigate mortality of birds and bats around existing wind turbines in the vicinity of MWPP.

Methods

There are currently nineteen wind turbines located at the MWPP. All nineteen are placed in a single row within a cleared area in the middle of a wheat field. Starting on the south end of the turbine row, the first eight turbines are refurbished 250kw Mitsubishi wind generators erected on tubular towers. Only two of these turbines were fully operational during the survey period. The northernmost eleven turbines in the turbine row are refurbished 65kw WindMatic wind turbines erected on lattice towers. All eleven of these turbines operated throughout the survey period. All nineteen turbines represent older generation, smaller, less efficient wind conversion technology compared to those proposed to be installed on the MWRA. The lattice tower structures are antiquated compared to modern tubular designs. The cleared area is approximately 100 meters wide by 1500 meters long.

Mortality surveys were conducted by walking transects. We walked one side of the turbines and then back along the other side of the cleared area. The search area was visually scanned for carcass remains. Additionally, half of the searches were assisted by dogs that accompanied the surveyor. Duration of search times ranged from thirty-five minutes to forty-three minutes over the course of 19 fatality surveys over the course of the study period from February through October 2007.

Results

No carcasses, feather spots or any evidence of bird fatalities were found during the study period.

OBJECTIVE V. Determine seasonal big game use in MWPP (spring, summer and fall).

Methods

Big game use was documented on the WRA or adjacent properties between February 21st and November 20, 2007. All big game observed was recorded on a weekly basis between the above dates, and on a bi-weekly basis between May 1 and June 30th. Surveys were conducted by vehicle, on foot or from observation points using 10x40 binoculars.

Results

Five species of big game animals were observed within or near the WRA: Mule deer (Odocoileus hemionus), American pronghorn (Antelocapra Americana), Rocky Mountain elk

(Cervus elaphus) and white-tailed deer (Odocoileus virginianus), and Black bear (Ursus Americanas).

Most North American ungulates show predictable patterns of movements over the course of a year, periodically returning to some original locality. The more general term “movements” is used in the literature, particularly in reference to migrations of relatively short distance. Mule deer did demonstrate a movement pattern and were abundant during the months of February and March during what appeared to be the late winter and spring green up period. Mule deer numbers dropped off in April and a small local population stayed during the birthing period (Table 8). Mule deer observations were closely linked to the ponderosa pine and riparian habitats on the MWPP. Mule deer reproductive habitat appears to be limited on the MWPP.

Table 8. Monthly average of Mule seen on or adjacent to MWPP.

Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.
122	76	22	15	10	11	9	22	32	10

Antelope were the most consistently abundant species observed on or adjacent to the MWPP during the survey period. Antelope social distribution results from discrete, autonomous herds and distinct geographic areas. Herds and doe bands are the basic social units; territorial bucks, bachelor buck bands are auxiliary and/or transitory social units. Social distribution reflects the combined influences of genetics, social behavior, tradition, and habitat response. Social groups acquire stability through social, behavioral, and habitat traditions involving specific land areas with traditional land use management (Pyrah, 1987). Antelope doe bands, bucks and does and fawns were all observed on the MWPP. No particular movement pattern was observed except during the fawning isolation period when productive females tended to spread out from the doe bands to fawn, and in the fall during the breeding period when territorial bucks attended the bands (Table 9.). The habitats we primarily observed the antelope in were Short-grass prairie, Dry land farm and fields adjacent to the riparian.

Table 9. Monthly average of Antelope seen on or adjacent to MWPP.

Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.
46	49	48	46	39	133	53	91	22	31

A black bear sow with cubs was observed on two occasions during the month of June. Two cow elk were observed on one occasion during the first week in June in the pine habitat. Both the Black bear and elk observations were linked with the timbered pine habitat on the MWPP. A large number of elk pellet groups were observed on the south facing slopes adjacent to the timbered ridges suggesting that the MWPP could be used as an elk wintering area. White-tailed deer observations were few and limited to the riparian habitat along Daisy Dean Creek.

Discussion

We were not provided with a proposed road access and turbine plan so we can only speculate on direct habitat loss. Typically, direct habitat loss from areas of wind development are small, thus the actual direct habitat loss from areas of permanent disturbance are expected to be relatively small of this MWPP.

The potential for direct mortality of deer, elk or pronghorn resulting from construction activities or vehicle collision is limited. Adults are typically mobile and would be able to avoid construction equipment or vehicles (unless they were traveling at high rates of speed). Newborn fawns or elk calves are more susceptible to mortality from vehicles and construction equipment given their instinctive behavior to lie still when danger is near.

Wildlife habitat needs are often described as food, cover, water and space consideration. These requirements sometimes overlook the security needs, particularly of non-hiding species such as antelope. Security cover and immediate access to this cover is critical to ungulates. Good habitat provides security. For hiding species, security means good hiding cover. Hiding cover for antelope has limited value except during the fawning time when the fawns hide in vegetation. Antelope defense attributes are their acute sight and running ability which relates back to providing them space and lack of disturbance. Security for antelope could be defined as habitat areas without constant human intrusion. Security and thermal cover for mule deer and elk are provided in the Ponderosa pine areas of the MWPP. Direct impacts to the pine and riparian habitat types should be avoided as much as feasibly possible. Construction activities would disturb and displace deer, elk and antelope in the vicinity of the construction areas. These temporary activities would also likely interfere with foraging, breeding, and migration activities depending on the timing and season during which construction occurs. Construction on winter range, if it occurs on the MWPP, could represent a potential significant adverse effect if human activities were to occur while these animals were occupying the range during the winter months. From our observations of mule deer in February, and the numerous elk pellet groups on the ridges, we suspect the area could be winter range for elk and mule deer. Horizon and the Montana Department of Fish, Wildlife and Parks conducted an aerial survey of all ungulates between December 1, 2007 and February 29, 2008 to determine the areas of greatest importance as winter range.

Potential impacts associated with Operations and Maintenance (O&M) of the proposed action would include general disturbance, behavioral interference and habitat fragmentation. Human activity and noise associated with turbine O&M vehicle traffic represent long-term disturbance effects that could potentially displace deer, elk and antelope. Given the adaptability of mule deer and sometimes antelope, such activities are not likely to substantially interfere with foraging, breeding, and migration activities. Given that that we only observed 2 elk and a limited number of white-tailed deer occur on the property, such activities are not likely to interfere with their foraging, breeding or feeding. We recognize that the proposed project is on private property and that Horizon Wind has no control over ranch vehicle use. However, if feasible it would be our recommendation that vehicle access to all areas be kept to a minimum, and contractors, maintenance and perhaps even ranch personnel could be instructed on ways to avoid disturbing and harassing animals to the maximum extent feasible.

OBJECTIVE VI. Determine threatened and endangered species use in MWPP.

Endangered Species

The U.S. Fish and Wildlife Service lists one endangered species that could be found within the wind resource area (WRA) (Table 1); the black-footed ferret (*Mustela nigripes*). This species has a recovery plan published by the USFWS and has an interagency working group/recovery team formed to facilitate recovery. The populations of ferrets released in upland habitats in eastern Montana are considered experimental non-essential populations because of their status as reintroduced animals.

Black-footed ferrets formerly occurred throughout the Great Plains, mountain basins, and semi-arid grasslands coincident with prairie dogs, their primary prey item (Hillman and Clark 1980). Ferrets have been the subject of experimental releases on prairie dog towns in several states after the last known wild ferrets were removed from the wild and captive bred to increase the population. The release sites in Montana are north and east from the proposed WRA. No ferrets are currently known to occur on prairie dog towns near the WRA; and no current potential exists for black-footed ferrets to occur due to the absence of prairie dogs towns. There is a large gap in the distribution of prairie dogs, the WRA, and reintroduction sites. Major threats to this species are the loss and fragmentation of its primary prey base, prairie dogs and disease.

Threatened Species

No threatened species occur in the project area.

Recently Re-Classified Species

One species recently re-classified from threatened status was found in the WRA (Table 2). The bald eagle (*Haleatus leucocephalus*) was listed as endangered in 1975, downlisted to threatened in 1995, and recently delisted from the Federal List of Endangered and Threatened Wildlife effective on August 8, 2007. However, the bald eagle remains protected under the Golden and Bald Eagle Protection Act of 1940 and the Migratory Bird Treaty Act of 1918.

Bald eagle recovery is directed by a state working group and also has a Montana state management plan (Montana Bald Eagle Working Group (MBEWG), 1996).

No bald eagle nests were found on the WRA and nesting habitat is limited. Only XX bald eagles were observed on the WRA during the study period Feb 15 – Nov. 15. These eagles were likely migrants as most were observed during the spring and fall migration period. Based on our observations, migrant eagles only use the property on a limited basis. Monitoring of nesting and migrant bald eagles is on-going in Montana and any efforts to support these in cooperation with state and federal agencies are recommended. If direct or indirect effects become present, through adaptive management efforts, it is recommended Horizon wind focus attention on these threats if applicable.

Peregrine falcons were also recently delisted and are currently being monitored in cooperation with state and Federal agencies pursuant to the Monitoring Plan for American Peregrine Falcons (U.S. Fish and Wildlife Service. 2003. Monitoring Plan for the American Peregrine Falcon, a Species Recovered under the Endangered Species Act. U. S. Fish and Wildlife Service, Division of Endangered Species and Migratory Birds and State Programs, Pacific Region, Portland, OR, 53pp). While no peregrine falcons were seen on the WRA, they may occur there during migration or while foraging from eyries located nearby.

Candidate Species
No candidate species were found in the WRA

Proposed Species
No proposed species were found in the WRA.

GENERAL WILDLIFE OBSERVATIONS

Mammals
Badger
Black bear
Red fox
Coyote
Porcupine
Richardson’s ground squirrel
Elk
Mule deer
White-tailed deer
Pronghorn antelope
White-tailed jackrabbit

MITIGATION RECOMMENDATIONS

Recommendations – It should be noted that because this project is located on private property many of the following recommendations and or suggestions would be strictly voluntary because most activities on private lands are, generally, not subject to government regulation. To the extent practicable we recommend the Project operator and private property owners work cooperatively to protect and/or improve the wildlife resources.

Turbines

- Implement a lighting scheme as required by FAA regulations to alert night migrants to turbines.

Power Lines

- Minimize the use of guy wires, whenever possible
- Use bird deflectors on power transmission lines
- Install raptor perch prevention devices on aboveground power line poles.
- Avoid bird electrocution by placing sufficient space between power line wires.
- Aerial inspection of lines should be avoided below 1,000 feet from November 15 through March 15 for wintering wildlife.
- Follow guidelines from Avian Power Line Interaction Committee (1994) and take corrective actions as needed and as reviewed by a Wildlife Technical Advisory Committee.

General Wildlife

- Place turbines at least ¼ mile from golden eagle nests.
- Establish and sign speed limits for all vehicles on roads.
- Restrict project vehicles to established roadways as much as practicable.
- All new fences built as part of the project should be wildlife friendly (smooth wire on top, minimum of 16 inches between ground and bottom wire) when landowner agrees.
- Work with landowner to reduce stress and cumulative adverse impacts to antelope through a voluntary program that might include removing and/or replacing portions of fence or leaving strategic openings in fences to allow easier passage for antelope if acceptable to the landowner and opportunities to make improvements arise.
- Minimize construction of new roads as much as feasible.
- Spring and fall road closures to outside, not ranch and/or project operations and maintenance, vehicle travel should be considered to protect critical big game winter/spring habitat.

Monitoring

- Fatality monitoring using most recent scientific and appropriate methods should be conducted for a minimum period of 1 year commencing at project start up. The objective of the fatality monitoring should be to estimate the number of avian and bat fatalities attributable to wind turbines and other project facilities. All avian and bat carcasses located within survey areas, should be recorded and a cause of death determined, if possible, based on field examination. After the first year, the monitoring protocols will be based on the recommendations of a Technical Advisory Committee (TAC) and earlier study results.

- Carcass searches should be conducted, as recommended by the TAC committe, of the turbines and other project facilities (substations, met towers, O&M facility) and using best scientific methods.
- Any carcass located should be photographed as found, GPS recorded, and distance from project facility recorded. Any threatened and endangered species carcass found should be labeled and appropriate Federal and state agency should be notified as soon as possible. Annual reports should be prepared summarizing each year survey effort.
- Annual Golden eagle nest occupancy and productivity surveys should be conducted.

Habitat Loss/Degradation

- Plant only native vegetation at any disturbed site outside of cropland.
- Prevent or limit the spread of invasive weeds onto the WRA.
- Prevent or discourage new invaders (invasive weed species not previously reported from establishing on the WRA.
- Cooperate with county and state agencies and adjacent private landowners interested in managing invasive weeds.

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BIRD

SPECIES

LIST

Common Name	Scientific Name	Season	Habitat	OB	B	PF	SB	GL	RM	RW	FF	FY	FB
Greater White-fronted Goose	*Anser albifrons*	M	ag lands, prairies, marshes	M	N			x	x	x	x		
Snow Goose	*Chen caerulescens*	M	marshy veg ag fields	E	N			x	x	x	x		
Ross's Goose	*Chen rossli*	M	marshy veg ag fields	E	N			x	x	x	x		
Cackling Goose	*Branta hutchinsii*	W	ag lands, prairies, marshes	E	N			x	x	x	x		x
Canada Goose	*Branta canadensis*	YR	open ground usu near water	O	E			x	X	x	X		X
Tundra Swan	*Cygnus columbianus*	M	ponds, rivers, marshes	E	N				x	x	x		
Wood Duck	*Aix sponsa*	S	water among trees	V	E					x			
Gadwall	*Anas strepera*	S	fresh & sheltered salt water	O	Y			X	X	x			
American Widgeon	*Anas americana*	M	fresh & sheltered salt water	O	Y			X	X	x			
Mallard	*Anas platyrhynchos*	YR	shallow water	O	Y			X	X	x	X		
Blue-winged Teal	*Anas discors*	S	shallow marshy ponds	O	Y				X	x			
Cinnamon Teal	*Anas cyanoptera*	S	shallow ponds w/marshy veg	O	Y				X	x			
Northern Shoveler	*Anas clypeata*	S	marshy ponds	O	E			X	X	x			
Northern Pintail	*Anas acuta*	S	ponds & marshes	O	Y			X	X	x			
Green-winged Teal	*Anas crecca*	S	shallow marshes, flooded field	O	E				X	x			
Canvasback	*Aythya valisineria*	S	lakes, marshy ponds	V	V				x	x			
Redhead	*Aythya americana*	S	lakes, marshy ponds, potholes	V	V				x	x			
Ring-necked Duck	*Aythya collaris*	M	freshwater ponds, marshes	E	N				x	x			
Lesser Scaup	*Aythya affinis*	S	marshy veg near lakes ponds	E	V				x	x			
Bufflehead	*Bucephala albeola*	M	lakes, bays	E	N				x	x			
Common Goldeneye	*Bucephala clangula*	W	lakes, rivers, bays, marsh, trees	E	N				x	x			
Hooded Merganser	*Lophodytes cucullatus*	M	wooded ponds	E	N				x	x			
Common Merganser	*Mergus merganser*	YR	lakes rivers	O	E				X	x			
Red-breasted Merganser	*Mergus serrator*	M	lakes	NE	N				x	x			
Ruddy Duck	*Oxyura jamaicensis*	S	ponds, lakes w/marshy veg	E	E				x	x			
Gray Partridge	*Perdix perdix*	YR	ag lands	O	Y	X	x	X	x		X		
Ring-necked Pheasant	*Phasianus colchicus*	YR	open fields w/brushy edges	EV	EV	x	x	x	x	x	x		
Ruffed Grouse	*Bonasa umbellus*	YR	dense decid forests	EV	EV					x			
Greater Sage Grouse	*Centrocercus urophasianus*	YR	sagebrush plains	O	Y		X	X					
Dusky Grouse	*Dendragapus obscurus*	YR	open conifer forests	O	Y	X							
Sharp-tailed Grouse	*Tympanuchus phasianellus*	YR	open grasslands brushlands	O	M		X	X					
Wild Turkey	*Meleagris gallopavo*	YR	open woodlands	V	E	x				x	x		
Common Loon	*Gavia immer*	M	open lakes, bays, ocean	EV	N								
Pied-billed Grebe	*Podilymbus podiceps*	S	ponds, open water, aquatic veg	E	V				x				
Horned Grebe	*Podiceps auritus*	M	marshy ponds, deep water	M	M				x				

Common Name	Scientific Name	Season	Habitat	OB	B	PF	SB	GL	RM	RW	FF	FY	FB
Eared Grebe	*Podiceps nigricollis*	S	marshy ponds	E	E				x				
Western Grebe	*Aechmophorus occidentalis*	S	lakes w/marshy veg	V	V								
Clark's Grebe	*Aechmophorus clarkii*	S	lakes w/marshy veg	V	V								
American White Pelican	*Pelecanus erythrorhynchos*	S	lakes, marshes	O	V				x				X
Double-crested Cormorant	*Phalacrocorax auritus*	S	open waters	V	V				x	x			
American Bittern	*Botaurus lentiginosus*	S	tall emergent marsh	E	E				x	x			
Great Blue Heron	*Ardea herodias*	S	colony tree nesters, open habitat	O	EV				X	X			X
Black-crowned Night Heron	*Nycticorax nycticorax*	S	colony tree nesters, water edges	E	V				x	x			
White-faced Ibis	*Plegadis chihi*	S	colony tree nesters, marshes	E	V				x	x			
Turkey Vulture	*Cathartes aura*	S	varied	O	E	x	x	X	x	x	x		X
Osprey	*Pandion haliaetus*	S	open water w/fish	EV	EV								
Bald Eagle	*Haliaeetus leucocephalus*	YR	lakes, rivers, coasts, tall trees	O	V	x			x	X			
Northern Harrier	*Circus cyaneus*	YR	marshes, grasslands, farm field	O	Y		X	X	X		X		X
Sharp-shinned Hawk	*Accipiter striatus*	YR	mature mixed forests	M	NE	x							
Cooper's Hawk	*Accipiter cooperii*	S	woods & edges, nests tall pine	V	E	x	x	x	x	x	x		
Northern Goshawk	*Accipiter gentilis*	YR	forests w/open areas, tall trees	O	E	x							
Swainson's Hawk	*Buteo swainsoni*	S	prairies, farmlands, isolat trees	V	E		x	x					
Red-tailed Hawk	*Buteo jamaicensis*	YR	widespread	O	Y	x	X	X	x	x	X		X
Ferruginous Hawk	*Buteo regalis*	S	arid grasslands,	O	Y		x	X			x		X
Rough-legged Hawk	*Buteo lagopus*	W	open habitat	E	N		x	x	x		x		
Golden eagle	*Aquila chrysaetos*	YR	open country	O	Y	X	X	X	X		X		X
American Kestrel	*Falco sparverius*	S	open habitats	O	Y	x	x	X	X	x	X		
Merlin	*Falco columbarius*	YR	forests w/open areas	V	E	x	x	x	x	x	x	x	
Peregrine Falcon	*Falco pereginus*	M	open areas esp near water	O	N		x	X	x	x	x		
Prairie Falcon	*Falco mexicanus*	YR	open deserts, grasslands, ag	O	E		x	X			x		
Virginia Rail	*Rallus limicola*	M	wet reedy marshes	E	N				x	x			
Sora	*Porzana carolina*	S	wet marshes	E	E				x	x			
American Coot	*Fulica americana*	S	ponds, marshes	O	E				X				
Sandhill Crane	*Gus canadensis*	S	meadows, marshes, riparian	O	Y			X	X	x	X		X
Semipalmated Plover	*Charadrius semipalmatus*	M	open mudflats & beaches	EV	N								
Killdeer	*Charadrius vociferous*	S	open ground	O	Y			x	X		X		
Mountain Plover	*Charadrius montanus*	S	short grass prairies	E	E			x			x		
Black-necked Stilt	*Himantopus mexicanus*	S	shallow muddy bottom ponds	E	E				x				
American Avocet	*Recurvirostra amercana*	S	shallow water	O	E				X				
Spotted Sandpiper	*Actitis macularius*	S	ponds & streams	EV	N				x				

Common Name	Scientific Name	Season	Habitat	OB	B	PF	SB	GL	RM	RW	FF	FY	FB
Solitary Sandpiper	*Tringa solitaria*	M	brushy ponds, ditches, mudflts	E	N				x				
Greater Yellowlegs	*Tringa melanoleuca*	M	shallow water or mudflat	E	N				x				
Willet	*Tringa semipalmata*	S	grassy marshes	E	E				x				
Lesser Yellowlegs	*Tringa flavipes*	M	shallow water or mudflat	E	N				x				
Upland Sandpiper	*Bartramia longicauda*	S	grassy fields	E	E			x			x		
Long-billed Curlew	*Numenius americanus*	S	nests on dry grasslands	O	Y			X	X		X		
Marbled Godwit	*Limosa fedoa*	S	mudflats, sandflats, beachs	V	EV				x				
Least Sandpiper	*Calidris minutilla*	M	mud or grassy mudflat	EV	N				x				
Long-billed Dowitcher	*Limodromus scolopaceus*	M	shallow ponds w/muddy bot	EV	N				x				
Wilson's Snipe	*Gallinago delicata*	S	grassy edges of ponds,	O	Y				X				
Wilson’s Phalarope	*Phalaropus tricolor*	S	shallow ponds, grassy marsh	O	Y				X				
Franklin's Gull	*Larus pipixcan*	M	beaches, lakes, farmlands	O	N			X	x		x		
Bonaparte’s Gull	*Larus philadelphia*	M	always around water	M	N				x				
Ring-billed Gull	*Larus delawarensis*	S	small lakes, rivers, ag lands	O	EV			X	x		X		
California Gull	*Larus californicus*	S	ponds, lakes	O	EV			X	x		x		
Herring Gull	*Larus argentatus*	M	open fields & marshes	NE	N			x	x		x		
Caspian Tern	*Sterna caspia*	S/M	sand islands	E	N								
Black Tern	*Chlidonias niger*	S	marshy ponds	E	E				x				
Forster’s Tern	*Sterna forsteri*	S	open water, marshes	EV	EV				x				
Rock Pigeon	*Columba livia*	YR	widespread	O	Y	X		x	X		X		
Mourning Dove	*Zenaida macroura*	S	mix open & brushy, ag	O	Y	X	X	X	x		x		
Black-billed Cuckoo	*Coccyzus erythropthalmus*	S	decid woods, wet open willows	M	M					x			
Great Horned Owl	*Bubo virginianus*	YR	forages forests & fields	O	Y	X	x	x	x	x	x		
Snowy Owl	*Bubo scandiacus*	W	open fields & marshes	M	N			x	x		x		
Burrowing Owl	*Athene cunicularia*	S	open grasslands, ag lands	E	E			x			x		
Long-eared Owl	*Asio otus*	S	forests, brshy flds, roost trees	M	M	x	x			x			
Short-eared Owl	*Asio flammeus*	YR	fields, marshes, oftn roosts grd	M	M	x	x	x	x				
Northern Saw-whet Owl	*Aegolius acadicus*	M	wooded areas	M	M	x				x			
Common Nighthawk	*Chordeiles minor*	S	open areas, nests on bare grd	O	Y	X		X					
White-throated Swift	*Aeronautes saxatalis*	S	rocky cliffs	M	M	x	x	x	x	x	x		
Calliope Hummingbird	*Stellula calliope*	S	riparian w/in conifer forests	V	EV	x			x	x			
Rufous Hummingbird	*Selasphorus rufus*	M	many habt, esp mdws, woods	V	N	x	x		x	x		x	
Belted Kingfisher	*Ceryle alcyon*	YR	sheltered open water	O	V				X	X			
Lewis's Woodpecker	*Melanerpes lewis*	S	dry open pine forests	E	E	x			x			x	
Red-headed Woodpecker	*Melanerpes erythrocephalus*	S	park-like woodlands	E	E	x				x			

Common Name	Scientific Name	Season	Habitat	OB	B	PF	SB	GL	RM	RW	FF	FY	FB
Williamson's Sapsucker	*Sphyrapicus thyroideus*	S	pine & fir forests	M	M	x							
Red-naped Sapsucker	*Sphyrapicus nuchalis*	S	mixed conifer	M	M	x							
Downy Woodpecker	*Picoides pubescens*	YR	any wooded habitat, esp ripar	E	E	x				x			
Hairy Woodpecker	*Picoides villosus*	YR	mature forests	O	Y	X				x			
Northern Flicker	*Colaptes auratus*	YR	wooded areas w/openings	O	Y	X		X		x			
Olive-sided Flycatcher	*Contopus cooperi*	S	boreal forests	V	N	x							
Western Wood-Pewee	*Contopus sordidulus*	S	mature decid, mix forests, edge	O	E	x			x	X			
Willow Flycatcher	*Empidonax traillii*	S	wet areas w/brushy veg willow	O	E				X	X			
Least Flycatcher	*Empidonax minimus*	S	mature decid w/brush undstry	E	E					x			
Hammond's Flycatcher	*Empidonax hammondii*	S	conifer or mixed forests	E	E	x				x			
Dusky Flycatcher	*Empidonax oberholseri*	S	brush patch in open forests	E	E	x				x			
Cordilleran Flycatcher	*Empidonax occidentalis*	S	shaded conifer	E	E	x							
Say’s Phoebe	*Sayornis saya*	S	open areas	E	E			x			x		
Western Kingbird	*Tyrannus verticalis*	S	open habitat w/ scattered trees	O	Y		X	X			X		
Eastern Kingbird	*Tyrannus tyrannus*	S	mix of grassy fields & trees	O	Y		X	X	X		X		
Loggerhead Shrike	*Lanius ludovicianus*	S	open pasture w/scat tree bush	E	E	x	x	x					
Northern Shrike	*Lanius excubitor*	W	open hab w/scat trees bushes	E	N	x	x	x					
Warbling Vireo	*Vireo gilvus*	S	large trees near water	E	E				x				
Red-eyed Vireo	*Vireo olivaceus*	S	broadleafed trees	E	E				x				
Gray Jay	*Perisoreus canadensis*	YR	coniferous woods	E	M	x							
Steller's Jay	*Cyanocitta stelleri*	YR	conifer & mixed woods	O	E	X				x			
Pinyon Jay	*Gymnorhinus cyanocephalus*	YR	pinyon pine forests	O	M	X							
Clark's Nutcracker	*Nucifraga columbiana*	YR	mature mixed conifers	O	Y	X							
Black-billed Magpie	*Pica hudsonia*	YR	prairies, parklands, pastures	O	Y	X		X			X		
American Crow	*Corvus brachyrhynchos*	S	widespread, open areas	O	Y	x	x	X	x	x	X	x	X
Common Raven	*Corvus corax*	YR	habitat varied	O	EV	X	x	X	x	x	x		X
Horned Lark	*Eremophila alpestris*	YR	sparsley veg pastures, ag	O	Y			X			X		
Tree Swallow	*Tachycineta bicolor*	S	tree cavities, fields water	O	Y	x	x	X	X	X			
Violet-green Swallow	*Tachycineta thalassina*	S	open areas water, cavities crvc	O	E			x	X				
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	S	banks crevices, water open are	O	Y			X	X				
Bank Swallow	*Riparia riparia*	S	sandbanks, mdws, water	O	Y			X	X				
Cliff Swallow	*Hirundo pyrrhonota*	S	forage field pond, nests edges	O	Y			X	X				
Barn Swallow	*Hirundo rustica*	S	man-made strctrs, field pond	O	Y			X	X	X		X	
Black-capped Chickadee	*Poecile atricapillus*	YR	any wooded habitat	E	E	x				x			
Mountain Chickadee	*Poecile gambeli*	YR	montane aspen & conifer	O	Y	X							

Common Name	Scientific Name	Season	Habitat	OB	B	PF	SB	GL	RM	RW	FF	FY	FB
Red-breasted Nuthatch	*Sitta canadensis*	YR	conifer & mixed woods	O	Y	X							
White-breasted Nuthatch	*Sitta carolinensis*	YR	mature woods	O	Y	X							
Brown Creeper	*Certhia americana*	YR	mature woods, wet shaded	E	E	x				x			
Rock Wren	*Salpinctes obsoletus*	S	talus slopes & rock expanses	O	Y	X		x					
Canyon Wren	*Catherpes mexicanus*	NE	canyons, rock features	O	?			X					
House Wren	*Troglodytes aedon*	S	brushy patches	E	E		x		x				
Marsh Wren	*Cistothorus palustris*	S/M	tall cattail reedy marshes	E	E				x	x			
American dipper	*Cinclus mexicanus*	YR	clear, fast flowing streams	V	V				x				
Golden-crowned Kinglet	*Regulus satrapa*	M	high in mature conifers	E	N	x							
Ruby-crowned Kinglet	*Regulus calendula*	S	wooded areas, nest in spruce	EV	EV	x			x	x			
Western Bluebird	*Sialia mexicana*	M	trees w/ open ground mix	M	M	x	x	x			x		
Mountain Bluebird	*Sialia currucoides*	S	open areas w/scat trees brush	O	Y	X	x	X			x		
Townsend's Solitaire	*Myadestes townsendi*	YR	open foests woodland edges	E	V	x							
Veery	*Catharus fuscescens*	S	willow thickets, other woods	E	E				x				
Swainson’s Thrush	*Catharus ustulatus*	S	mature mixed woods	M	M					x			
Hermit Thrush	*Catharus guttatus*	S	dry brushy forests, esp P-O	M	M	x							
American Robin	*Turdus migratorius*	S	open woodlands	O	Y	X		X	X	X	x		
Gray Catbird	*Dumetella carolinensis*	S	brushy understory of woods	O	Y				X	x			
Brown Thrasher	*Toxostoma rufum*	S	dense brush	E	E		x						
Sage Thrasher	*Oreoscoptes montanus*	S	sagebrush plains	E	E		x						
European Starling	*Sternus vulgaris*	YR	widespread, around humans	O	Y	X	x	x	x	x	X	x	X
American Pipit	*Anthus rubescus*	S/M	open grounds, fields	O	M			x			X		
Bohemian Waxwing	*Bombycilla garrulus*	W	variety of habitats	E	N				x	x		x	
Cedar Waxwing	*Bombycilla cedrorum*	YR	fruit & other food, brushy	O	E				x	X		X	
Tennessee Warbler	*Vermivora peregrina*	M	variety of brushy habitats	M	N	x	x		x	x		x	
Orange-crowned Warbler	*Vermivora celata*	S	dense decid brush, willows	E	E				x	x		x	
Yellow Warbler	*Dendroica petechia*	S	wet brushy habitat	O	Y				X	X			
Yellow-rumped Warbler	*Dendroica coronata*	S	open conifer and their edges	V	V	X			X	x			
Townsend’s Warbler	*Dendroica townsendi*	M	mature conifer, high in trees	E	N	x							
Blackpoll Warbler	*Dendroica striata*	M	dense conifer w/ sm opening	M	N	x							
Black-and-white Warbler	*Mniotilta varia*	M	deciduous or mixed forests	M	N					x			
American Redstart	*Setophaga ruticilla*	S	deciduous forests w/ wet	E	E					x			
Ovenbird	*Seiurus aurocapillus*	S	mature decid or mixed forests	V	V				x	x			
Northern Waterthrush	*Seiurus noveboracensis*	S	near water dense brush trees	O	Y				X	x			
MacGillivray’s Warbler	*Oporonis tolmiei*	S	brushy decid patches	E	E				x	x			

Common Name	Scientific Name	Season	Habitat	OB	B	PF	SB	GL	RM	RW	FF	FY	FB
Common Yellowthroat	*Geothlypis trichas*	S	low wet areas	O	Y				X	x			
Wilson's Warbler	*Wilsonia pusilla*	S	brushy woods near water	E	E				x	x			
Yellow-breasted Chat	*Icteria virens*	S	dense brushy patches	E	E				x	x			
Western Tanager	*Piranga ludoviciana*	S	conifer & deciduous wood	O	Y	x			X	X			
Green-tailed Towhee	*Pipilo chlorurus*	S	sagebrush & other brush	E	E		x						
Spotted Towhee	*Pipilo erythrophthalmus*	S	open forests, brushy	E	E	x	x		x	x			
American Tree Sparrow	*Spizella arborea*	W	brushy weedy habitats	V	N	x	x		x	x			
Chipping Sparrow	*Spizella passerina*	S	open woodlands, edges	O	Y	X							
Clay-colored Sparrow	*Spizella pallida*	S	open areas w/scat bushes	O	Y		X	X					
Brewer's Sparrow	*Spizella breweri*	S	sagebrush	O	E		X						
Vesper Sparrow	*Pooecetes gramineus*	S	sparsley veg pastures, ag	O	Y			X			X		
Lark Sparrow	*Chondestes grammacus*	S	open grassy w/scat trees	O	E	x		x	X	x			
Lark Bunting	*Calamospiza melanocorys*	S	open shortgrass prairies	E	E			x					
Savannah Sparrow	*Passerculus sandwichensis*	S	open grassy weedy areas	O	Y			x	X	x			
Grasshopper Sparrow	*Ammodramus savannarum*	S	grasslands w/shrubs or weeds	E	E		x	x					
Baird's Sparrow	*Ammodramus bairdii*	S	lush prairie	E	E			x					
Fox Sparrow	*Passella iliaca*	S	dense brush in montane	EV	EV	x							
Song Sparrow	*Melospiza melodia*	YR	brushy areas near water	O	Y				X				
Lincoln's Sparrow	*Melospiza lincolnii*	S	dense brushy areas	E	E		x		x	x			
White-throated Sparrow	*Zonotrichia albicollis*	M	brushy patch/wood opens	E	N	x	x		x	x			
White-crowned Sparrow	*Zonotrichia leucophrys*	S	brushy patches	O	E		X	X					
Dark-eyed Junco	*Junio hyemalis*	YR	open conif, mixed woods	V	E	x							
McCown's Longspur	*Calcarius mccownii*	S	dry, short grasslands	O	E			x			x		
Lapland Longspur	*Calcarius lapponicus*	W	winters on open ground	E	N			x			x		
Chestnut-collared Longspur	*Calcarius ornatus*	S	dry prairies, slightly wet	E	E			x					
Snow Bunting	*Plectrophenax nivalus*	W	winters on open ground	E	N			x			x		
Black-headed Grosbeak	*Pheucticus melanocephalus*	S	wooded or brushy habitat	E	E					x			
Lazuli Bunting	*Passerina amoena*	S	brushy weedy, esp stream	E	E				x	x			
Bobolink	*Dolichonyx oryzivorus*	S	grasslands, fallow fields	V	E			x	x		X		
Red-winged Blackbird	*Agelaius phoeniceus*	YR	marshes, weedy ditches	O	Y			X	X		X		
Western Meadowlark	*Sturnella neglecta*	YR	arid grasslands	O	Y	X	X	X			X		X
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	S	marshes	O	Y			X	X	X	x		
Brewer's Blackbird	*Euphagus cyanocephalus*	S	ag fields, open areas	O	Y			X	X		X	X	X
Common Grackle	*Quiscalus quiscula*	S	dense trees, open woods	M	M	x				x		x	
Brown-headed Cowbird	*Molothrus ater*	S	open or patchy woodland	O	Y	x			X	X		x	

Common Name	Scientific Name	Season	Habitat	OB	B	PF	SB	GL	RM	RW	FF	FY	FB
Bullock's Oriole	*Icterus bullockii*	S	decid trees w/open areas	O	E				x	X		X	
Baltimore Oriole	*Icterus galbula*	M	open decid woodlands	M	M					x		x	
Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*	W	open rocky hillsides	E	N			x			x		
Pine Grosbeak	*Pinicola enucleator*	W	conifer forests, fruit trees	E	N	x							
Cassin's Finch	*Carpodacus cassinii*	YR	open pine forests	E	E	x							
House Finch	*Carpodacus mexicanus*	YR	patchy, brushy, wooded	E	E	x			x	x		x	
Red Crossbill	*Loxia curvirostra*	YR	pines and other conifers	O	E	X							
White-winged Crossbill	*Loxia leucoptera*	W	hemlocks, spruces	EV	N	x							
Common Redpoll	*Carduelis flammea*	W	nomadic, willows & birch	E	N	x	x		x	x		x	
Pine Siskin	*Carduelis pians*	YR	nomadic, open forests	O	Y	X			X	x			
American Goldfinch	*Carduelis tristis*	S	orchards, overgrown fields	E	E				x	x		x	
Evening Grosbeak	*Coccothraustes vespertinus*	W	coniferous & deciduous forests	EV	N	x				x			
House Sparrow	*Passer domesticus*	YR	widespread	E	E							x	

Common Name	Scientific Name	Season	Habitat	OB	B	PF	SB	GL	RM	RW	FF	FY	FB

Key:
Season:
YR = year round
S = summer
W = winter
M = migrant
/ means it is on range line

OB (observation):
E = expected to occur on site
EV = exptect to occur in vicinity
O = observed on site
V = observed in vicinity
NE = within range, but not expected
M = maybe it'll occur on site

B (breeding):
Y = breeding on site
N = will not breed on site
E = expected to breed on site
EV = expected to breed in vicinity
M = maybe will breed on site
NE = not expected to breed on site

Habitats:
PF = pine forest
SB = sage brush
GL = grassland
RM = riparian marsh
RW = riparian woodland
FF = farm field
FY = farm yard
FB = flyby
X = observed in that habitat
x = expected to use that habitat

NEST

LOG

NEST LOG

N1	RTHA, active
N10	FEHA, on rock ledge, no young observed but a pair observed on nest
N11	GOEA, 1 chick
N12	BBMA nest
N13	BBMA nest
N14	GOEA, 2 chicks initially, later only 1 fledged
N15	MOCH, active, hole in snag only about 1’ above ground
N16	Active NOHA nest in vicinity
N17	RODO, nest in bank, active
N18	WBNU, active, in old growth pine
N19	BBMA
N2	Duck, eggs, active, porcupine predation, failed
N20	Grass nest knocked out of tree
N21	MOBL, 3 nestlings
N22	AMKE, active
N23	MOBL, active
N24	NOFL, active
N25	AMKE, cavity near top of pine, believed to have been active, 1st mail was killed then female by predator
N26	GHOW, active
N27	Med sized stick nest near top of tree, corvid
N28	Small stick nest in fork near top of tree
N29	Large stick nest, middle of pine about 20 ft above ground

N3	WEME, active
N30	Stick nest near top of pine
N31	Stick nest, empty, about 15’ up in top 1/3 of tree, platform type
N32	BBMA, vacant, lower ½ of tree
N33	Stick nest in middle of tree, corvid?
N34	Small stick nest in top fork of pine, about 40’ above ground grass nest in lower 1/3 of tree about 12’ above ground, empty, new, inside is
N35	about 3” in diameter
N36	Stick nesat near top of tree, about 20’ above ground
N37	Small stick nest in upper half of pine, about 20ft.
N38	Small stick nest in top fork of pine about 45’ above ground fairly flat messy stick nest, small, lined w/ pine needles, about 15 ft above
N39	ground
N4	PRFA aerie, active
N40	Stick nest lined w/ mud
N41	Small stick nest in upper ½ of tree, about 15’ above ground
N42	Small stick nest near top of pine about 258 ft above ground
N43	Small stick nest near top of tree about 25 ft above ground stick nest, cup shaped, 4-5” deep by about 6-7” wide, lined w/ mud, manure, pine
N44	needles, moss, about 8’ above ground
N45	BBMA nest in top of pine
N46	Messy stick nest in middle of pine
N47	Old stick nest in top half of pine
N48	BBMA
N49	Stick nest lined with mud
N5	VESP, 4 eggs

N50	Stick nest out on limb about 50 ft above ground
N51	Stick nest about 10 ft above ground in pine
N52	Stick nest
N53	Small grass nest in lower branches of pine
N55	small stick nest in dead pine, cup shaped, about 4” deep by 6” wide, lined w/ mud Manure, pine needles, about 7’ above ground
N56	Med to lrg stick nest, inactive
N57	BBMA, active, upper 1/3 of pine about 25’ above ground
N58	BBMA, about 35’ above ground near top of tree
N59	Med stick nest about 15-20’ above ground, shallow cup-shaped, lined w/ grass
N6	BBMA
N60	small nest towards end of branch, made of twigs, grass, pine needles, about 25’ above ground in lower to mid branches of tree
N61	small nest made with twigs, grass, pine needles, and lined w/ bark, empty, about 10’ above ground
N62	small stick nest made w/ med. Lrg stick near top fork of pine, about 15’ above ground
N63	Unfinished? Stick nest near top of tree, about 15’ above ground
N64	Sm to med stick nest platform near top of tree, about 30’ above ground
N65	Nest in cavity of old snag
N66	Corvid stick nest
N67	Corvid stick nest
N68	Stick nest
N69	Small stick nest at top of pine
N7	BBMA
N70	Stick nest

N71	Flat stick nest, empty, lined w/ pine needles, about 6” diameter
N72	Shallow, messy stick nest lined w/ pine needles in lower branches about 10’ above ground
N73	Stick nest, about 10” wid by 6” high in top fork of pine, about 30’ above ground
N74	Small stick nest about 40’ above ground in top fork of pine
N75	Active RTHA
N76	RTHA, active?
N77	WBNU, active
N78	Active
N79	MOBL nest in large corner post, active
N8	BBMA
N80	MOBL, active
N81	MOBL nest near
N82	GOEA nest, vacant
N83	Large stick nest in tree above old car
N84	RODO nest in cliff holes
N85	SACR nest in vicinity
N86	NOHA nest in vicinity
N87	NOHA nest in vicinity?
N88	GOEA nest, fledged 1 chick
N89	GHOW nest in vicinity
N9	CLSW, 70 active intact nests

AMPHIBIANS

Common Name	Scientific Name	Habitat	Suitable Habitat	OB
tiger salamander	*Ambystoma tigrinum*	quiet waters in variety of habitats	yes	V
tailed frog	*Ascaphus truei*	cold, rocky streams in forested habitat	no	M
plains spadefoot	*Spea Bombifrons*	prairies, sagebrush, grasslands, farms	yes	E
boreal toad	*Bufo boreas boreas*	variety of habitats	yes	E
Woodhouse's toad	*Bufo woodhousii*	variety of habitats	yes	E
great plains toad	*Bufo cognatus*	grasslands and scrub/brushlands	yes	E
western chorus frog	*Pseudacris triseriata*	pools, lakes, & marshes	yes	E
Columbia spotted frog	*Rana luteiventris*	ponds in diverse habitats	yes	E
northern leopard frog	*Rana pipiens*	variety of habitats	yes	E

APPENDIX A

Infrared USA, Inc.

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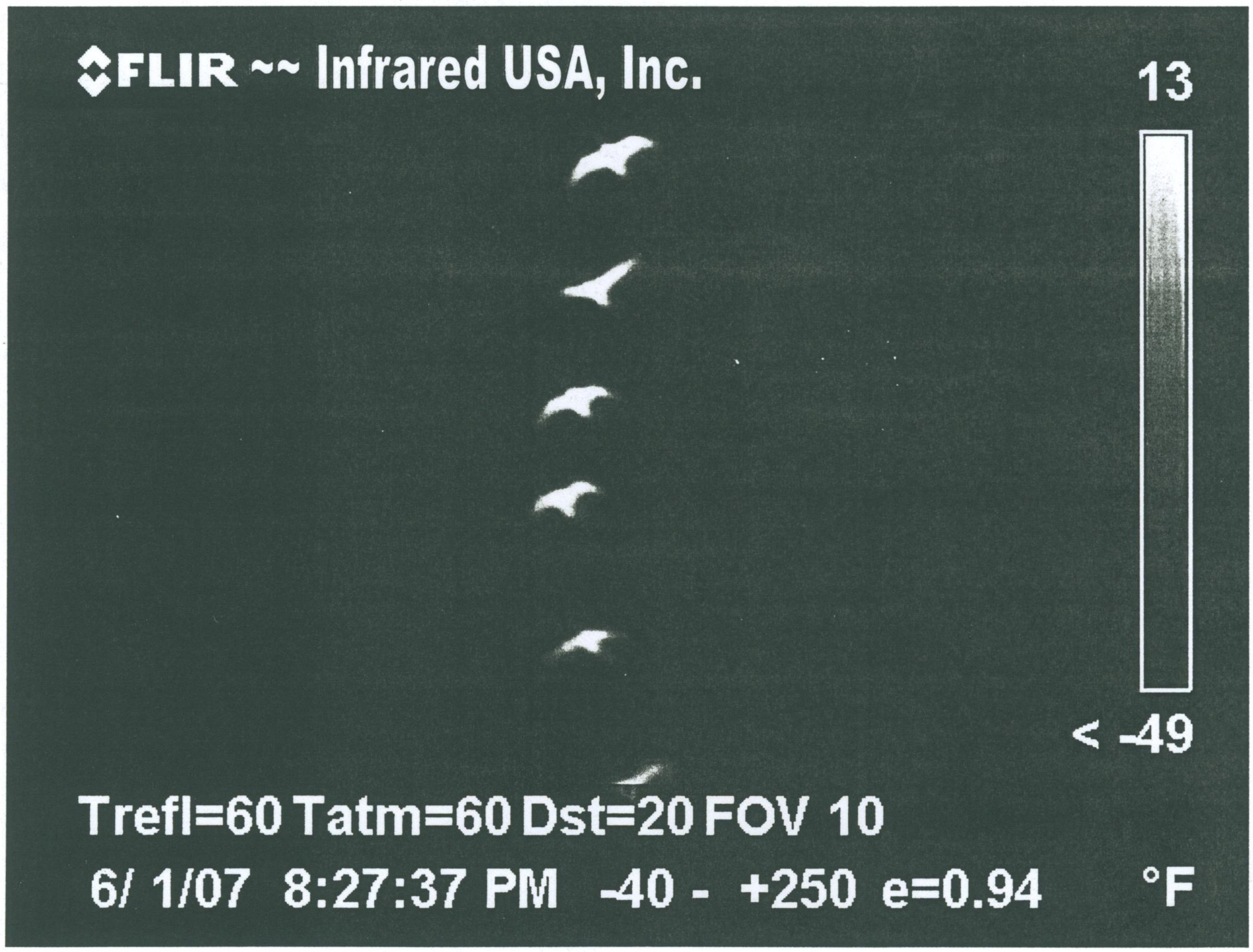

Bill Schwahn, Level 2 Thermographer
Infrared USA, Inc.

Infrared USA, Inc.
P.O. Box 440, Belgrade, MT 59714
Office (406) 388 9890 fax (406) 388-0039
www.infraredusa.us
"Thermography, a revealing vision"

Thermography Report

Customer: Ranchland Management
Address: P.O. Box 4322, Helena, Montana

Thermography date:	June 1, 2007
Thermography time:	2045-2315 hrs
Thermographer:	Bill Schwahn, Level 2 Thermographer
Outdoor temperature:	59-45 degrees °F
Weather:	Partly Cloudy

INFRARED USA

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INFRARED USA

Introduction

On June 1, 2007, an experimental evaluation using Infrared Thermal Imaging (Thermography) was conducted at the Martinsdale Wind Resource Area specifically at the met tower and at the Daisy Dean creek location.

Objective

The objective of the experimental evaluation was to determine if Infrared Thermal Imaging Technology could detect bats in flight.

Equipment

The equipment that was used was a FLIR Industries P65HS Infrared Thermal
Imaging Camera with a 12 degree specific lens .66mrad tuned to the camera
Following are the technical specifications:
The Field of View minimum focus distance was 19" x 14"/0.3m,
Spatial Resolution (IFOV) was 1.1 mrad,
Thermal sensitivity @ 50mK at 30 degrees C (86 degrees F),
Electronic Zoom-2, 4, 8 interpolating,
Power: 2 -2hour batteries with/ AC/DC Converter
640 x 480 pixels full color,
Temperature ranges -40c to +120degreees-Range 1
0 degrees C +250 degrees C, Range 2,
+150 degrees C to +500 degrees C, Range 3,
Accuracy of Reading +/- 2 degrees C or +/-2%

Result

The result of the evaluation was that Infrared Thermal Imaging (Thermography) did locate bats in flight as confirmed visually and by Acoustic detectors at maximum distances of approx. 200 ft. Birds were detected at ranges of approx. 500 ft in flight . See report dated June 1, 2007.

Field of View

The Field of View could not be positively determine by this Thermographer or FLIR industries, due to the fact that to determine the field of view the size and dimension of each object in the field of view would need to be determined in order to calculate the Field of View, which was not possible because the object was in flight. The approx. Field of View was determined at the site by using the Thermal Camera to shoot fixed objects with known distances, met tower, vehicles, etc.

Introduction

The **second** evaluation was conducted on August 30, 2007 and September 2-3, 2007 at the Martinsdale Wind Resource Area.

Locations

On August 30, 2007, the area evaluated was at the met tower and the bluff area to the north of the met tower. On September 2, 2007, the area evaluated was at the met tower and at the bluff area to the north of the met tower On September 3, the evaluation was conducted at the Daisy Dean Creek area N.E. of the met tower, and at the upper bench west of the Daisy Dean Creek site and at the base of the met tower.

Objective

To locate bats in flight during migration, with the use of Infrared Thermal Imaging Technology.

Equipment

A FLIR Industries P65HS camera was used with the above listed specifications. An Archos 704 portable DVD recording device was attached to the camera for continuous recording of all events in a DVD format for continuous viewing and recording. The Archos 704 has a 80GB storage for 25 hours of continuous recording time.

Determining Factors

Birds were differentiated from bats by the following procedure:

<u>Flight Patterns</u>: It was determined during the June 1, 2007 exploratory evaluation that the flight patterns of bats was very erratic and not uniform in nature, while the flight pattern of birds was straighter with very little deviation in direction.

<u>Size:</u> Birds were much larger in size and dimension, this allowed the Thermographer to identify wing flap during flight on some of the patterns.

<u>Thermal Signature:</u> The thermal signature of birds was much larger with a thermal trail behind the birds in some sightings, this appeared to be dependant on size. Bats had a much smaller thermal signature and in the majority of the sightings there were no thermal trails behind the bat sightings.

It is very important to note that there were many sightings that could not be identified due to the following factors; speed, distance, elevation and field of view.

Results

Date: August 30, 2007- Times: Evaluation Start: 08:33:15 p.m. End: 10:58:55 p.m.
Temperature: 83 degrees F@ start.
Wind: North to N.E. @ 10-15 mph @ 08:15 pm, 9:05pm the wind stopped,
9:29pm wind started blowing moths and insects to the north, sightings decreased.
Total sightings: 79

Date: September 2, 2007, Times: Start: 09:10:33 p.m. End: 11:01:53 p.m.
Temperature: 79 degrees F @ start Wind: 8:10-negligible , 9:10pm -10.7 mph-north
Total sightings: 272

Date: September 3, 2007, Times: Start: 8:05:49 p.m. End: 11:10:56
Temperature: 69 degrees F @ start 59 degrees F @ 8:36pm
Wind: 1-5 mph from east @ start.
Total Sightings: 134

Enclosures

Please review the enclosed:

1. Chronological documentation of in flight images captured by the infrared camera for each evening of thermography
2. 3 -- DVD's documenting bird/bat sightings – one for each evening

Bill Schwahn –Level 2 Thermographer
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INFRARED
USA

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Martinsdale Thermography Observation Project
August 30, 2007
07:35:16pm ~~ 10:58:55pm

Chapter I ~~ 07:35:16
Truck @ 276 yds 160° degrees

Chapter II ~~ 7:37:59
Met Tower

Chapter III ~~ 8:33:07
08:33:15 Night Hawk
08:33:33 Night Hawk 50 yards
08:33:47 Night Hawk
08:33:58 bat – acoustics confirmed
08:34:45 Night Hawk – 30 yds
08:34:54 "
:55 "
:56 "

Chapter IV ~~ 8:35:37
NE Valley Views

Chapter V ~~ 8:46:28
Panning horizon and fields

Chapter VI ~~ 8:57:09
08:57"18 bat
09:00:00 *Ridge N of Met Tower*
09:05:44 Bird -

Chapter VII ~~ 9:06:33
09:06:51 bat – l to r
09:06:17 bat - top to bottom
09:07:20 bat - l to r
09:07:58 bat - r to l
09:08:04 bat - top l to bottom r
09:08:11 Night Hawk – l to r - wingflap
09:09:38 ? – mid r to upper l
09:10:12 bat – mid l to upper r
09:11:04 bat – top to bottom
09:11:38 bat – l to r
09:14:31 bat – l to r
09:15:33 bat – l to r
09:17:16 *Moved Camera to 60°*

Chapter VIII ~~ 9:32:31
09:18:11 bat – middle screen to up
09:19:23 bat – l to r
09:20:30 bat – r to l
09:21:03 ? – l to r - bat or moth
09:21:54 bat – top middle to middle r
09:26:32 Bird – mid screen to l – maybe bat
09:27:51 Bird – slowly across top of screen
09:31:37 Bird – right across front of camera

Chapter IX ~~ 9:32:31
09:32:08 ? – left to bottom middle
09:37:49 bat – l to r close to camera

Chapter X ~~ 9:54:00
09:54:19 bat
09:54:41 bat – l to r
09:56:06 bat – r to l
09:56:20 bat – lower r to mid bottom
10:01:31 bat – r to l mid screen
10:01:53 bat – top r to mid l
10:02:28 bat – mid r to lower l
10:02:43 ? mid screen to low l - faint
10:05:11 Bird – mid l to low r
10:05:36 bat – mid screen
10:05:42 bat – low middle to lower l
10:06:21 ? – top mid to left
10:06:41 bat – top mid under cloud to l
10:07:05 bat – center, edge of cloud thru center
10:07:40 bat – zig from r top to lower l
10:08:18 bat – r to l
10:08:50 bat – bottom r corner l to mid bottom

Legend : Looks like - B=Bird b-bat ?=? Direction: Right = r Left = l

10:12:11	bat – mid top to left
10:12:50	Bird – top to bottom
10:12:58	bat – top to bottom left
10:14:08	bat – Top to bottom
10:14:13	bat – mid r to mid bottom
10:15:53	bat – Mid to l
10:16:38	Changed distance
10:17:25	bat – top to bottom – very faint
10:17:55	bat – top r to left
10:18:34	bat – top r to bottom l
10:19:09	Bird – top r to l
10:20:35	? – l to r - SLOW
10:21:35	? – l to r – Bird?
10:21:38	Bird – top to mid l
10:22:45	bat – mid r to top
10:22:47	bat – r to l
10:23:02	Bird - top r to lower l
10:23:44	bat – top to bottom
10:24:44	Move to top of Met Tower
10:32:14	bat – mid l to bottom r
10:32:58	Bird — top r to lower l - Night Hawk?
10:39:32	bat –l bottom across corner
10:45:12	bat – l to r
10:50:13	Bird – mid l to r
10:54:51	Bird – top l to mid r
10:54:59	? – bott l to up r – b?
10:55:09	bat – l to r
10:55:40	bat – r to lower l
10:55:42	bat – bott l to r top
10:58:55	Camera is Shutting down

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Martinsdale Thermography Observation Project

September 2, 2007
9:10:33pm ~~ 11:01:53pm

Chapter I ~~ 09:10:33

09:10:33 *At Met tower-support wires visible*
09:10:39 ? - top l to lower r – b or moth?
09:11:46 ? - mid top to mid bott – b or moth?
09:12:10 b - r to l on top
09:13:50 b - l to r
09:14:44 b - l to r
09:15:04 b - center out
09:15:07 b - l to r in front of tower
09:15:16 b - bott r corner
09:15:53 b - l to r in front
09:16:05 b - top to r
09:16:10 b - center to l
06:16:17 b - mid l to bott center
09:16:53 b - mid l to mid r
09:17:25 b - #1 – center to top
- #2 – top l to low r behind tower
09:17:44 b - r to lower l
09:17:54 b - l to r behind tower
09:18:14 Bright flash in sky that lingers
09:18:26 b - lower r to upper l
09:20:02 ? - center to mid left – moth?
09:20:05 b - top middle to mid r
09:20:08 b - top l to r top
09:20:16 b - top mid to r top
09:20:30 ? - flash across screen

09:25:46 b - mid bott to top r
09:25:17 b - l to r behind tower
09:26:23 ? - top r to lower l
09:26:49 b - mid top to upper l
09:27:07 *Camera adjustment*
09:27:23 b - mid top to lower r
09:27:26 Bird – mid l to mid r
09:27:32 b - across bottom of screen
09:27:36 b - lower r to upper l
09:27:24 Someone walks in front of camera
09:28:24 Bird - mid r to lower l
09:28:33 b - top r corner to mid l
09:28:39 b - bott then up, left and to screen
09:28:58 b - mid screen to mid top
09:29:02 ? - top right corner
09:29:03 b - mid screen up to mid top
09:29:12 b - mid l to r top
09:29:18 b - mid r turn to bott r corner
09:29:49 b - mid screen rt –
09:29:59 b - top r to low l –
09:30:00 Someone in front of camera
09:30:01 b - top l corner to mid top
09:30:49 ? - low r to low l
09:30:58 - 9:31:43 Camera adjustment
09:32:16 b - top r to mid l
09:32:41 - 9:33:00 Camera adjustment
09:33:08 Someone walks in front of camera
09:33:10 b - upper r to mid top
09:33:41 b - upper r to left
09:33:49 b - lower l to upper r

Chapter II ~~ 9:34:00

09:35:15 b - mid l to mid r
09:35:38 b - upper r to top
09:36:22 b - upper r to l
09:36:28 b - top l side to mid top
09:36:40 Bird – l top to top r
09:27:07 Bird – mid screen
09:37:18 b - lower l to top r
09:37:38 Bird – across bottom of screen
09:36:51 b - lower l to top r
09:36:53 b - lower l to top l
09:38:01 b - mid bottom to mid top
09:38:04 b - #1 mid top to upper rt
- #2 lower r to upper l
09:38:40 b - mid l to mid top
09:39:23 - upper l to mid r
09:40:16 b - top ctr to mid rt
09:40:32 Bird = mid r to lower l

Legend : Looks like - B=Bird b-bat ?=? Direction: Right = r Left - l

09:40:57 b - lower r corner to upper l
09:42:53 Bird – r to l
09:42:53 Bird – top to bottom
09:43:30 b - lower l to mid bottom
09:44:05 Bird – mid r to lower l
09:44:06 b - mid l to mid bottom
09:44:10 b - mid l to upper r
09:44:28 b - upper r to l
09:44:32 ? - m left to top
09:44:58 Shoulder in FOV
09:45:01 Person in FOV
09:45:07 b - top ctr to mid r
09:45:37 Bird – mid l to upper r
09:45:51 Bird – upper l to upper rt
09:45:40 Bird – mid bott to mid r
09:47:37 b - upper l to mid bottom
09:47:40 Bird – mid r to mid top
b - mid bott to mid top, down, up,left, up to mid top
09:47:54 b - l corner to mid top
09:48:07 Bird – upper r, around up to mid top
09:48:08 b - upper l to lower r
09:48:25 Bird
09:49:45 Bird – upper r to upper l
09:50:22 b - mid top to mid l
09:50:26 Bird – top r to upper rt corner
09:50:54 ? - blob lower l across FOV– moth?
09:50:58 b - lower r to upper l
09:51:59 Bird – lower l corner to upper r
09:52:04 b - upper r to mid l
09:52:09 b - upper l to mid r
09:52:13 Bird – upper r corner to lower l
09:52:33 b - bottom center to lower r
09:52:39 Bird – top ctr to up r corner
09:52:43 b - mid l to mid r
09:52:50 b - lower l to upper r
09:53:06 b - mid l to mid r
09:53:18 b - bott l to top r
09:54:24 b - mid screen to lower r
09:54:38 b - mid r to center top
09:54:40 b - mid left to lower r corner
09:55:08 Camera adjustment
09:55:57 ? - lower l to upper r – Moth ?
09:55:57 b - lower l corner to upper r
09:56:33 b - upper l to lower r
09:56:37 Bird – top r to bottom center
09:56:42 b - mid top to mid r
09:56:48 Bird – top r corner to bottom l
09:57:03 b - mid screen to upper l
09:57:35 b - lower l to bottom l
09:58:19 b - lower l corner to mid bottom
09:58:28 b - mid l to mid top
09:58:46 - 09:58:53 Camera adjustment
09:58:58 b - center black to lower left
09:59:41 b - mid top to mid r

Chapter III ~~ 10:00:00

10:00:29 b - mid top to lower r
10:00:36 Bird – mid l to top r corner
10:01:15 Bird – top r to lower l
10:02:01 b - mid r to upper l
10:02:31 b - mid r to bottom l
10:02:51 Bird – lower l corner to top r corner
10:03:01 b - #1 mid r to mid l
- #2 mid bottom to mid r
10:03:16 Bird – mid l to mit r
10:03:33 Bird – center bott to center top
10:04:09 Bird – lower l to upper l
10:04:15 b - mid screen to mid bott
10:04:22 ? - top l to lower l – close to lens
10:04:29 b - across top r to l
10:04:43 b - lower r to upper l
10:06:53 b - mid r to upper l
10:07:02 B - #1 lower r to top l- *wing flap
- #2 mid top down to lower
- **side by side mid screen**
10:07:27 b - lower l to upper r in front of lens
10:27:39 - 10:27:44 Someone in front of lens
10:27:49 - 10:27:52finger test in front of lens
10:09:15 b - lower l corner to upper r
10:09:20 - 10:06:43 Camera adjustment
10:09:57 b - r to l behind tower
10:10:21 - 10:10:31Camera to sky above tower
10:10:45 b - lower l to bottom r
10:11:01 b - mid r to bottom center
10:12:01 - 10:12:12 Refocus Camera
10:12:24 B - mid r to lower l
10:12:54 b - upper l to top r
10:13:18 ? - across upper r corner
10:13:39 b - across lower l corner
10:14:20 b - lower l to mid r
10:14:37 ? - lower r to mid top – Moth?
10:15:21 b - mid bottom to top r
10:15:28 b - upper l across corner
10:16:08 b - mid r to lower l
10:16:47 b - upper l to top l
10:17:05 b - mid center to upper r
10:17:28 B - X 2 a pair mid r to mid l
10:18:01 b - top r to lower l
10:18:31 b - mid center to top center

Legend : Looks like - B=Bird b-bat ?=? Direction: Right = r Left - l

10:19:25	?	- across upper r corner
10:19:34	b	- lower r to top center
10:19:44	b	- top l to bottom l
10:19:53	b	- lower l to top center
10:20:50	b	- lower r to mid l
10:21:31	b	- bottom r to top center
10:21:43	Bird – bottom r to mid top	
10:21:56	b	- mid r to top l
10:22:21	?	- mid l to bottom ctr
10:23:01	b	- mid bottom to mid l
10:23:27	b	- center screen to top r
10:23:34	b	- mid r to center top
10:23:29	-	10:24:15 Bright spot center r
10:24:21	b	- low center to mid top
10:24:24	b	- lower r to upper l
10:25:00	b	- mid l to center bottom
10:25:05	b	- mid bottom to upper l
10:25:12	b	- mid r to lower l
10:25:28	b	- top r to bottom l
10:26:25	b	- bottom center to top r
10:26:36	b	- top l to mid bottom
10:26:40	Bird – upper l to upper r	
10:26:49	b	- mid r to top center
10:26:54	b	- mid r to upper l
10:27:42	b	- center to top r
10:28:28	?	- flash across mid screen
10:28:43	b	- across top l corner
10:29:24	b	- top r to top l
10:29:28	b	- mid l to top l
10:29:44	b	- mid bottom to top r
10:30:09	Bird – mid l to r	
10:30:24	b	- bottom l to mid top
10:30:33	b	- mid r to up l

<u>Chapter IV ~~ 10:31:00</u>

10:31:36	b	- mid r to lower l
10:32:06	b	- mid bottom to upper r
10:32:11	b	- mid bottom to top r
10:32:12	b	- mid l to center top
10:33:01	b	- lower r to center top
10:33:58	b	- bottom l to top r
10:34:15	b	- mid bottom to mid r
10:34:17	b	- mid bottom to lower l
10:34:40	b	- mid bottom to top r
10:35:06	b	- lower r to mid l
10:35:45	b	- mid center to top l
10:36:03	Bird – top l corner to bottom r corner	
10:36:05	Bird – l to r	
10:36:34	b	- lower r to upper l
10:36:57	b	- bottom l to lower l
10:37:01	b	- mid l to top r
10:37:24	Pink Screen	
10:38:57	b	- top l to lower l
10:39:11	b	- mid bottom to mid l
10:41:10	b	- lower r to mid l
10:41:40	-	10:41:56 Camera adjustment
10:41:55	b	- upper r across upper r corner
10:42:05	b	- lower r to mid l – faint
10:43:11	b	- mid l to mid top
10:43:56	?	- across lower l corner
10:44:17	b	- mid r to center, back to r
10:44:19	b	- upper r to mid l
10:44:36	b	- lower r to top r
10:45:44	-	10:45:59 Camera adjustment
10:46:22	b	- top left to lower l corner
10:47:33	b	- low center to lower r corner
10:47:55	b	- upper r to mid top
10:48:52	?	- upper l to mid top
10:49:17	b	- lower r to lower l
10:49:44	b	- bottom l to ctr then lower r
10:50:06	b	- center screen to top r
10:50:23	b	- center screen to upper r
10:50:38	Bird – top of center to upper r	
10:50:47	b	- lower l to center
10:51:31	b	- top r to mid l
10:52:17	b	- mid l to lower r
10:52:33	b	- mid bottom to upper r
10:52:50	b	- mid bottom to lower l
10:53:04	?	- top r to mid bottom
10:53:12	Bird – mid bottom to mid r	
10:53:54	Bird – mid bottom to top r corner	
10:54:15	b	- mid bottom to mid r
10:54:27	?	- flash bottom to top l side
10:54:49	b	- lower r to mid top
10:55:26	Bird – top r to bottom r	
10:55:50	b	- top r to mid top
10:56:50	b	- mid r to top l
10:57:22	b	- mid l to mit top
10:57:48	b	- lower r to mid top
10:58:43	Bird – lower l to mid top	
10:59:08	Bird – bottom l to top l	
10:59:09	b	- bottom r to top r
10:59:23	b	- lower r to upper l
10:59:24	b	- #1 – Bird – lower r to mid bottom #2 – b – upper r to top l
10:59:32	?	- across lower l corner
10:59:56	b	- mid bottom to lower l
11:00:12	b	- mid top to upper l
10:00:13	?	- across lower l corner
11:00:33	b	- mid bottom to upper r

11:00:35 Bird – lower l to upper r
11:00:38 Bird – mid bottom to mid top
11:01:06 Bird – mid r to upper l
11:01:53 Camera shut off

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Martinsdale Thermography Observation Project

September 3, 2007
8:05:37pm – 11:10:56pm

Chapter I ~~ 08:05:37

08:05:49	B - top l to r
08:06:15	- 08:16:17 Camera adjustment
08:17:54	Camera refocus
08:18:39	B – Night Hawk - l to r center in bushes
08:18:54	B x 2 – NH r side center above bushes
08:19:24	B – NH center at bushes
08:19:51	B – NH center of screen to l side
08:20:10	B -l to r across lower screen-greyscale
08:20:20	Bird - center of screen to l – N H ?
08:20:35	Bird - N H center of screen
08:20:38	Bird - N H center of screen to l side
08:21:07	Bird - N H mid r to center – greyscale
08:21:08	- 08:21:17 –Someone in F O V
08:21:25	2 Dogs in field
08:21:33	- 08:21:38 –Dogs and person in FOV
08:22:16	- 08:31:13 Camera adjustment
08:33:08	b - center of screen to mid l
08:38:19	Panning horizon
08:38:44	b - up to sky during panning
08:40:01	Camera refocus and set on sky
08:40:09	b - mid top to top r
08:40:12	b - mid l to mit top
08:40:23	b - mid l to upper r
08:40:35	b - up l side to mit top
08:40:40	b - center screen to top r
08:41:02	b - upper l to mid top
08:41:06	b - center up to mid top
08:41:08	b - across top r corner
08:41:10	b - center to r top corner
08:41:12	b - upper l to top r
08:41:22	b - mid l to r top
08:41:32	b - upper l to mid r
08:42:02	b - bottom l to upper r
08:42:21	b - across bott of screen behind #'s
08:42:24	b - mid l to upper r
08:42:31	b - lower l to upper r
08:42:46	b - mid l to upper r
08:43:11	Bird – NH? Upper l to upper r
08:43:20	Camera adjustment
08:44:13	Bird – upper l to upper r
08:44:17	Bird - top l to lower r
08:44:20	b - center screen to top r
08:44:23	? – flash across screen- Bird?
08:44:32	Camera adjustment
08:46:00	b - mid bottom to lower r
08:46:04	b - upper l to upper r
08:46:08	b - mid r to bottom l
08:46:14	b - center screen to mid r
08:46:16	b - lower r to mid bottom to mid l
08:46:35	b - mid top to upper l
08:46:50	? - in front of lens to the l – Moth?
08:47:00	b - bottom l to upper r
08:47:09	b - center top to upper r
08:47:16	b - center of screen to mid r
08:47:18	b - mid l to upper r
08:47:34	b - top l to mid l
08:47:40	b - lower r to upper l
08:48:04	- 08:48:12 Camera adjustment
08:48:40	b - top l to upper l
08:49:01	? - mid bottom to top r
08:49:02	b - mid top to mid l
08:49:21	b - mid l to mid top
08:49:27	? - top of mid screen
08:49:35	b - bottom r to top r
08:50:11	b - top middle to mid r
08:50:17	? - mid l to bottom r
08:52:17	? - mid r to upper l
08:52:23	? - across upper r corner
08:54:15	- 08:55:00 Camera adjustment
08:55:04	b - lower l to mid top
08:55:18	b - lower l to bottom l
08:55:43	Camera Adjustment
08:56:02	b - top l to mid r- followed flight
08:56:28	b - lower l to mid top
08:56:34	b - mid center to top l

Legend : Looks like - B=Bird b-bat ?=? Direction: Right = r Left - l

08:57:20 b - lower l to upper r
08:57:27 b - center screen to mit top
08:57:59 B - mid top, down, l then r
08:58:17 b - lower l to upper r
08:58:23 b - lower l to top r
08:58:43 ? - across top r corner
08:59:11 - 08:59:34 Camera adjustment
08:59:29 b - mid l to mid r
08:59:41 Bird - mid r to bottom l
08:59:52 b - top r to bottom l
09:01:06 b - top l to mid r
09:01:37 b - lower l to lower r
09:01:43 Bird - lower rt to lower l
09:02:03 b - lower left to mid r
09:02:06 b - mid left to mid r
09:02:19 Bird - top r around center to mid r
09:02:35 b - upper r to mid l
09:03:03 ? - across bottom of screen
09:03:07 b - center of screen to top r
09:04:41 ? - top l to lower r -- ?b
09:05:22 Bird - mid r to top l – corkscrew
09:06:32 B - mid top to mid bottom – interesting air –
09:06:33 b - mid l to upper r
09:06:50 ? - across top r
09:08:42 Bird - top r to mid l
09:10:24 ? - upper l to mid l
09:11:11 ? - mid l to top middle
09:13:27 Camera shutoff – move to flats at butte above Daisy Dean

Chapter II ~~ 9:30:50

09:30:57 ? Stationary object in field
09:32:46 Someone walks in front of camera Camera adjustment
09:34:53 b - top r to bottom r
09:35:08 b - mid r to bottom l
09:35:43 - 09:35:58 Refocus- obj in field
09:36:35 ? - across bottom l corner
09:36:36 ? - top l to lower l
09:36:49 ? - top r to bottom l
09:42:15 b - top middle to mid l
09:45:01 ? - mid r to top l
09:47:11 Body shadow top r corner
09:48:11 Another body part – finger
09:48:46 ? - l side of screen
09:49:00 - 50 Camera adjustment – emissivity
09:52:45 b - upper l to top r
09:54:40 b - bottom r to med top
09:55:22 b - mid bott to top l
09:58:12 b - mid r to top r
09:59:28 b - top r to mid r
10:01:01 b - mid top to lower l
10:02:21 b - mid bottom to mid l
10:06:04 - :10 Emissivity adjustment
10:06:47 - :59 Emissivity adjustment
10:08:11 b - top middle to upper r
10:13:04 Camera shutdown – move to Met Tower

Chapter III ~~ 10:40:45

10:41:06 - 10:41:49 Camera adjustment
10:42:02 b - bottom r to top left
10:42:17 Bird - top l to bottom r
10:43:31 Bird - mid r to top middle
10:43:49 Bird - mid bottom to mid l
10:44:25 b - mid bottom to mid top
10:45:10 ? - mid bottom to top l
10:46:31 ? - top l to lower r
10:50:06 b - mid r to top middle
10:50:38 b - mid r to top l
10:50:53 b - lower r to mid bottom
10:55:19 b - lower r to top l behind tower
10:55:52 b - mid bott to mid top-behind tower
10:57:34 b - upper r to top r
10:58:00 b - bottom r to top r
10:59:48 b - lower r to mid top
11:02:00 b - center screen to top l
11:03:06 b - lower r to top l
11:05:33 Bird – r to l
11:07:34 Bird
11:09:24 Bird – lower l to top middle
11:10:56 Camera Shutdown

Legend : Looks like - B=Bird b-bat ?=? Direction: Right = r Left - l

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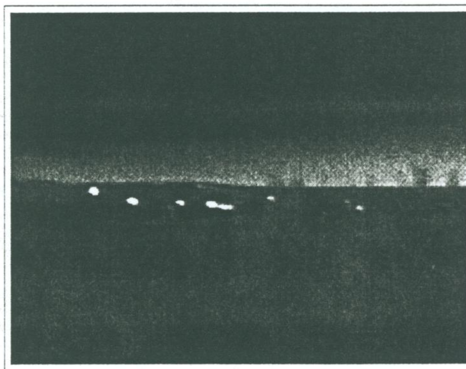
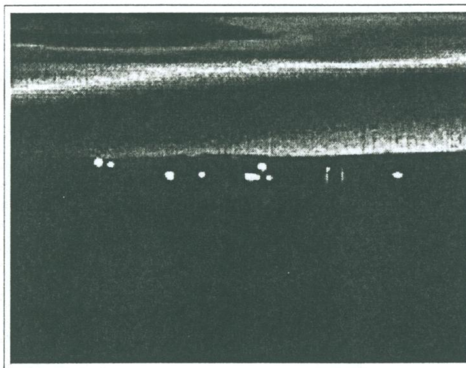
Picture 1 **Captured at: Cattle-N.E. of location 1,250 yards as determined with the use of a rangefinder by Mr. Hazelwood.**

Date & Time: 6/1/2007 8:15:52 PM



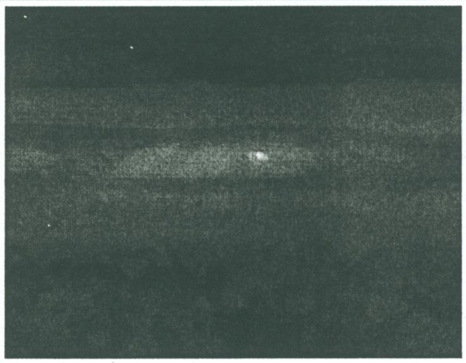
Picture 2. **Captured at: Captured at: Cattle-N.E. of location 1,250 yards as determined with the use of a rangefinder by Mr. Hazelwood.**

Date & Time: 6/1/2007 8:15 p.m.



Picture 3. Captured at: Hill south of location approx. 195 yards

Date & Time: 6/1/2007 8:21:44 PM



Picture 4. Captured at: Shed and Cattle-198 yards south of location as measured with a rangefinder by Mr. Rob Hazelwood.

Date & Time: 6/1/2007 9:00 p.m.

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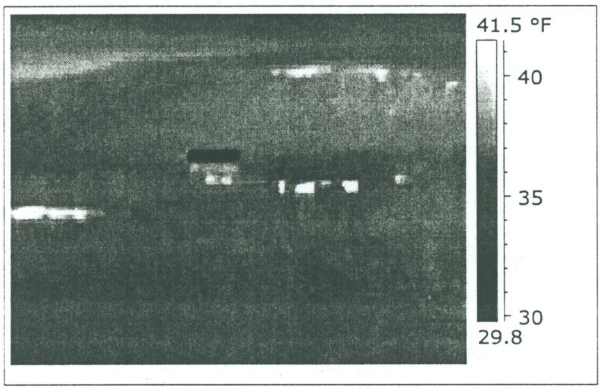
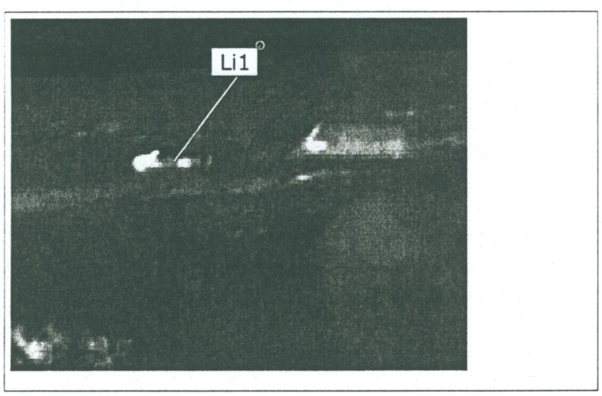
Picture 5. Captured at: Shed and Cattle 198 yards south of location, as confirmed by a range finder.

Date & Time: 6/1/2007 8:23:53 PM

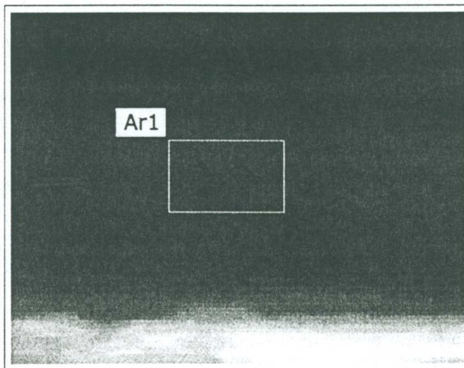


Picture 6. Captured at: Al's truck N.E. of location 550 yards as measured with a range finder by Mr. Hazelwood. LI-1 Represents location of vehicle. Front of vehicle is hotter than the rest of the vehicle due to the engine.

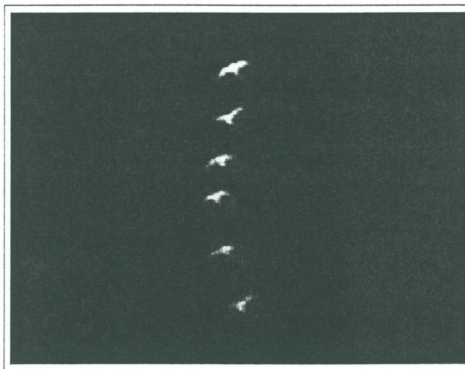
Date & Time: 6/1/2007



Picture 7. **Captured at: Geese southeast of location AR-1, visually confirmed.**
Date & Time: 6/1/2007 8:27:17 PM

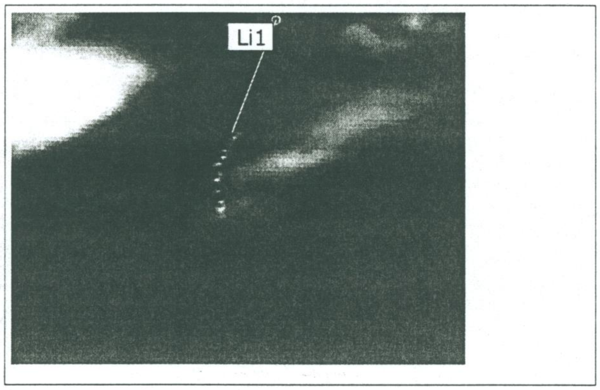


Picture 8. **Captured at: Geese overhead, visually confirmed.**
Date & Time: 6/1/2007



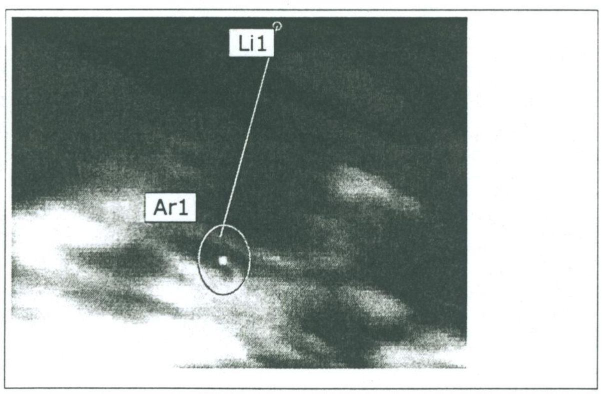
Picture 9. Captured at: Geese flying, N.W. approx. 750 yards-Li1

Date & Time: 6/1/2007 8:28:02 PM



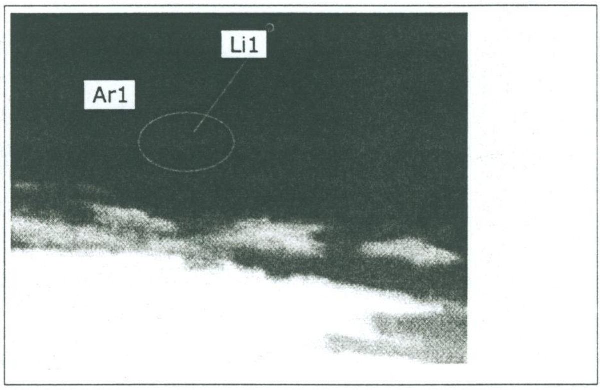
Picture 10. Captured at: N.W. sky-bat visually confirmed by Mr.Flath

Date & Time: 6/1/2007



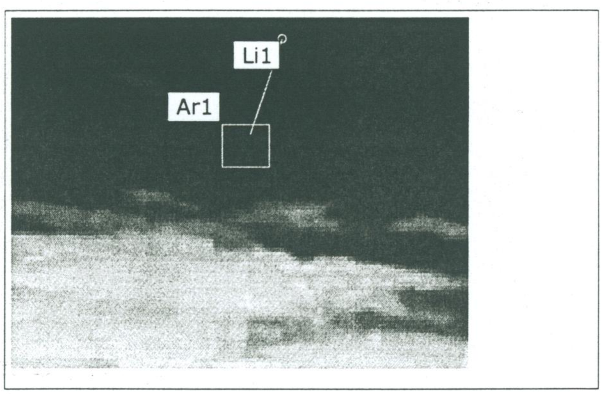
Picture 11. Captured at: Bat-N.W. of location.

Date & Time: 6/1/2007



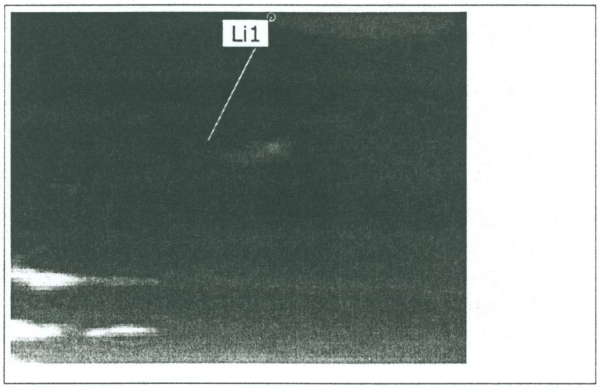
Picture 12. Captured at: Bat-N.W. of location at approx. 60 degrees

Date & Time: 6/1/2007



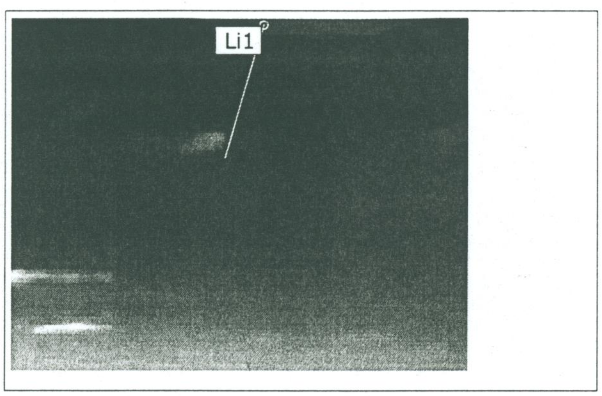
Picture 13. Captured at: North –Northwest- Unconfirmed visually-- L1 object appears to be a bat, as the object is consistent with other confirmed bat infrared images.

Date & Time: 6/1/2007 8:49:37 PM



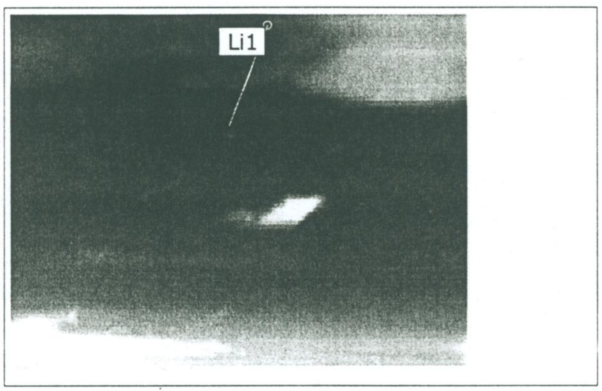
Picture 14. Captured at: Northwest of location- L1 object was visually confirmed as a bat. Unable to determine distance.

Date & Time: 6/1/07 8:52 p.m.



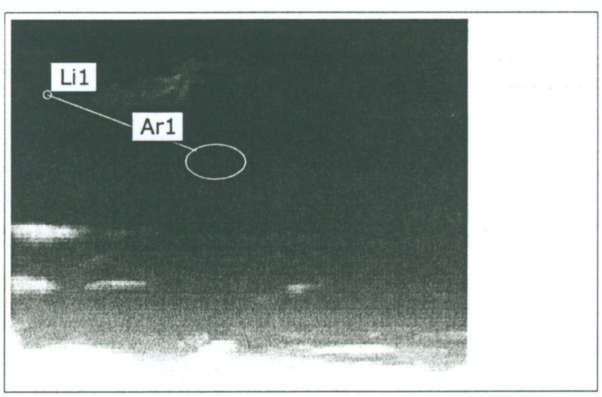
Picture 15. Captured at: Northwest of location-L1 was visually confirmed as a bat. Unable to determine distance.

Date & Time: 6/1/2007 8:50:12 PM



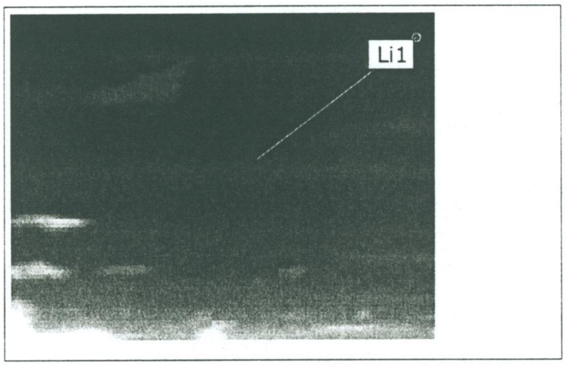
Picture 16. Captured at: North of location, unable to visually confirm object. Line 1 and Area 1.

Date & Time: 6.1/2007 8:50 p.m



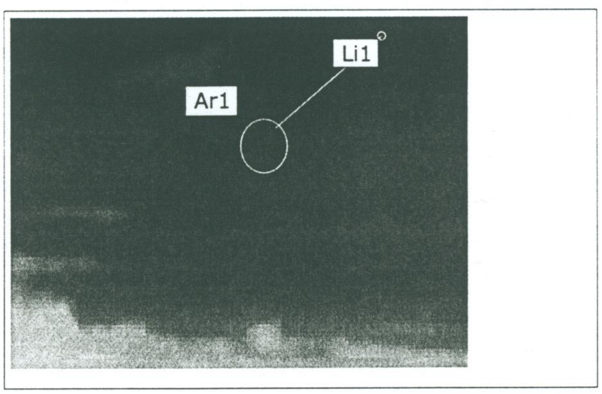
Picture 17. Captured at: Northwest of location, unable to visually confirm object or distance.

Date & Time: 6/1/2007 8:51:29 PM



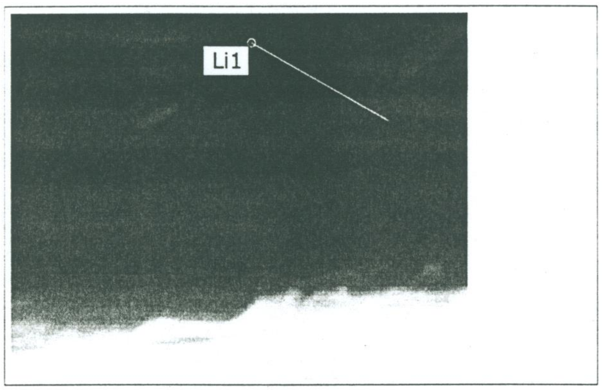
Picture 18. Captured at: N.W. of location –visually confirmed as bat. L1 and Ar1 confirm location.

Date & Time: 6/1/07 8:53 p.m.



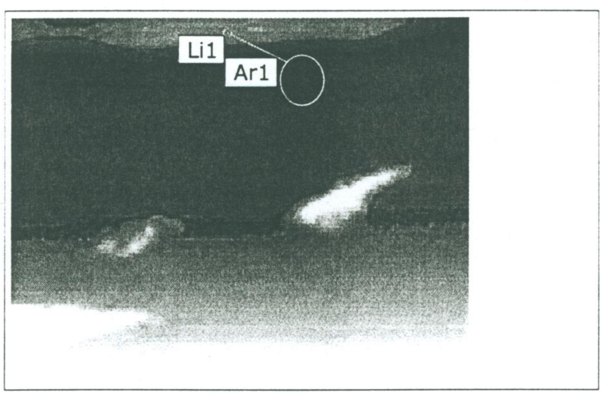
Picture 19. Captured at: Northwest of location, unable to visually confirm due to distance.

Date & Time: 6/1/2007 8:54:00 PM



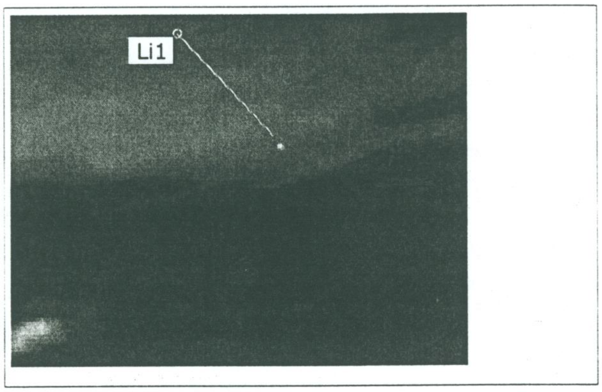
Picture 20. Captured at: West of location, unable to determine object due to distance

Date & Time: 6/1/2007 8:55:16 PM



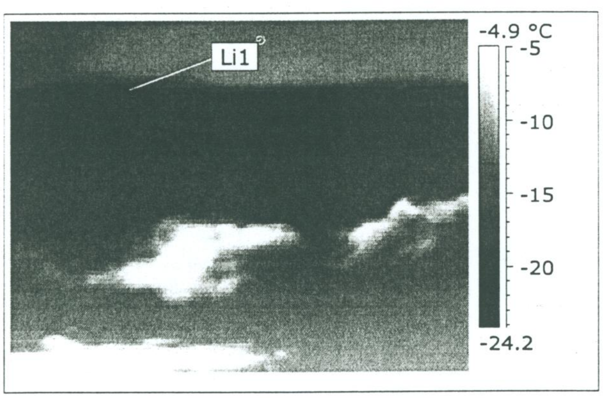
Picture 21. Captured at: North west of location, L 1 appears to be a bat as it is consistent with other infrared photos of confirmed bats.

Date & Time: 6/1/07 8:56 p.m.



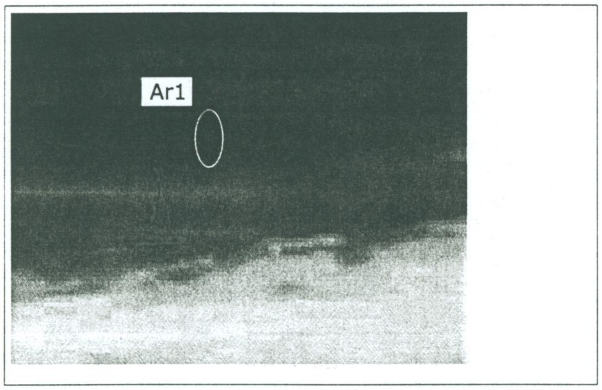
Picture 22. Captured at: S.W. of location. Unable to visually confirm, size is consistent with other visually confirmed bat infrared images.

Date & Time: 6/1/2007 8:57:38 PM



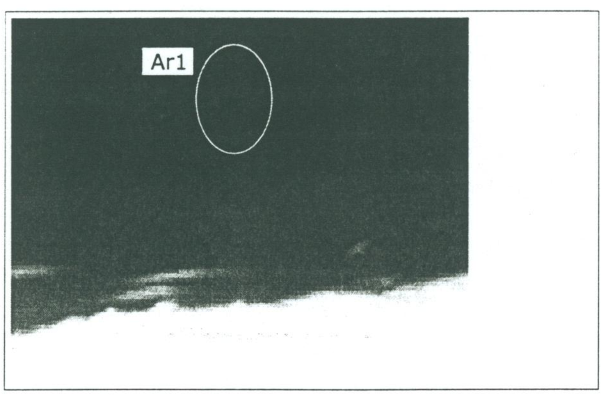
Picture 23. Captured at: Northwest of location. Unable to confirm object.

Date & Time: 6/1/07



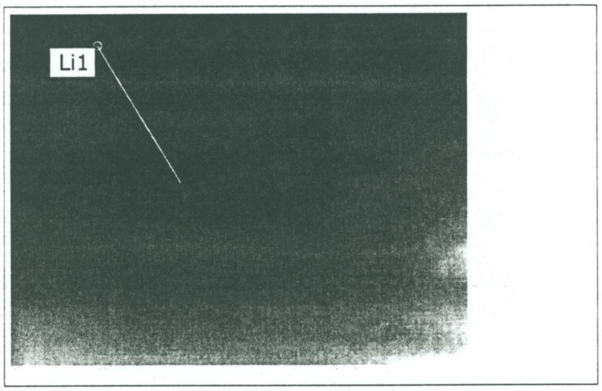
Picture 24. Captured at: Northwest of location, unable to confirm object due to distance.

Date & Time: 6/1/2007 9:02:11 PM



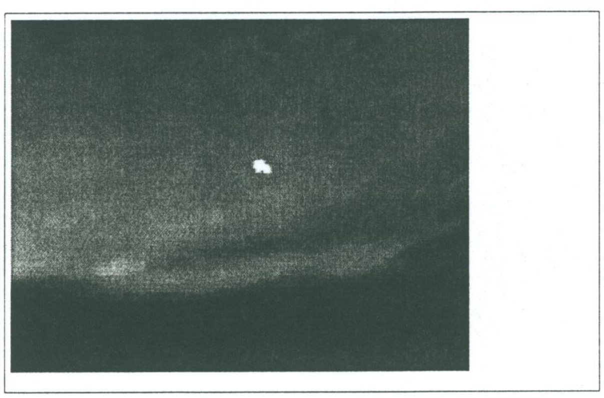
Picture 25. Captured at: Northwest of location. Unable to visually confirm due to distance, object is the same size and consistency of other confirmed infrared images showing bats.

Date & Time: 6/1/2007 9:18:19 PM



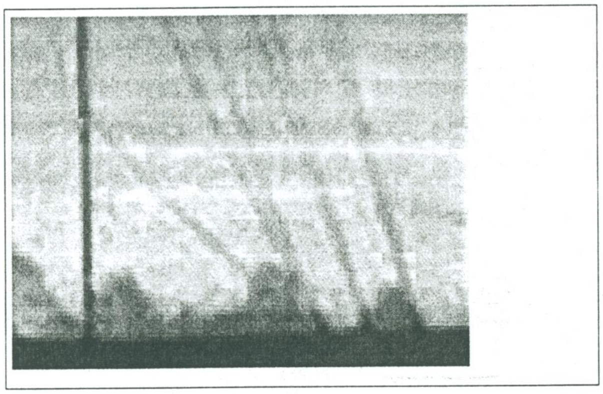
Picture 26. Captured at: Northwest of location, unable to confirm object visually, this object is too large for a bat and appears to be consistent with a duck or goose.

Date & Time: 6/1/07 9:20 p.m.



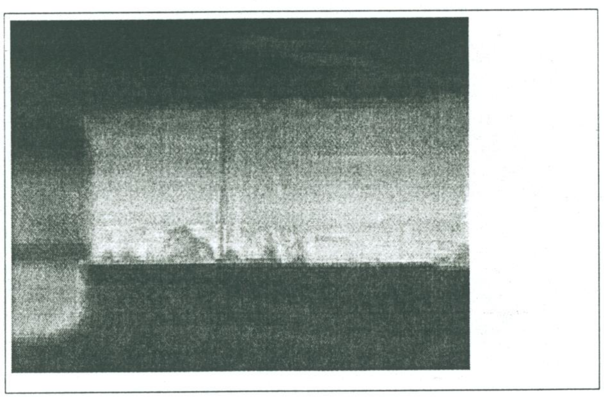
Picture 27. Captured at: S.E. of campsite-guide wires on the tower monitor station. This is approx. 250 yards away at total dark, this is magnified 4 x.

Date & Time: 6/1/2007 10:06:30 PM

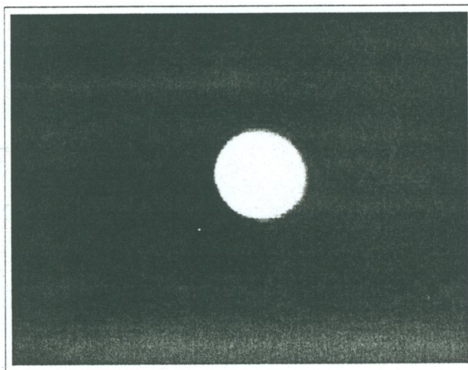


Picture 28. Captured at: S.E. of campsite-tower monitor station. No zoom, actual photo.

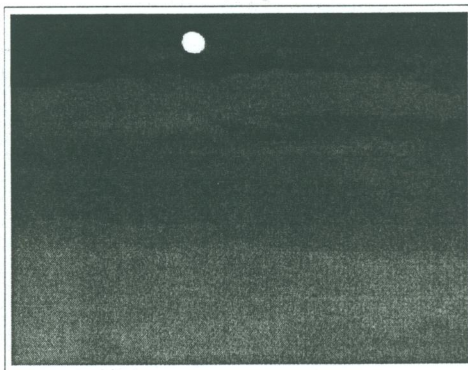
Date & Time: 6/1/07 10:07 p.m.

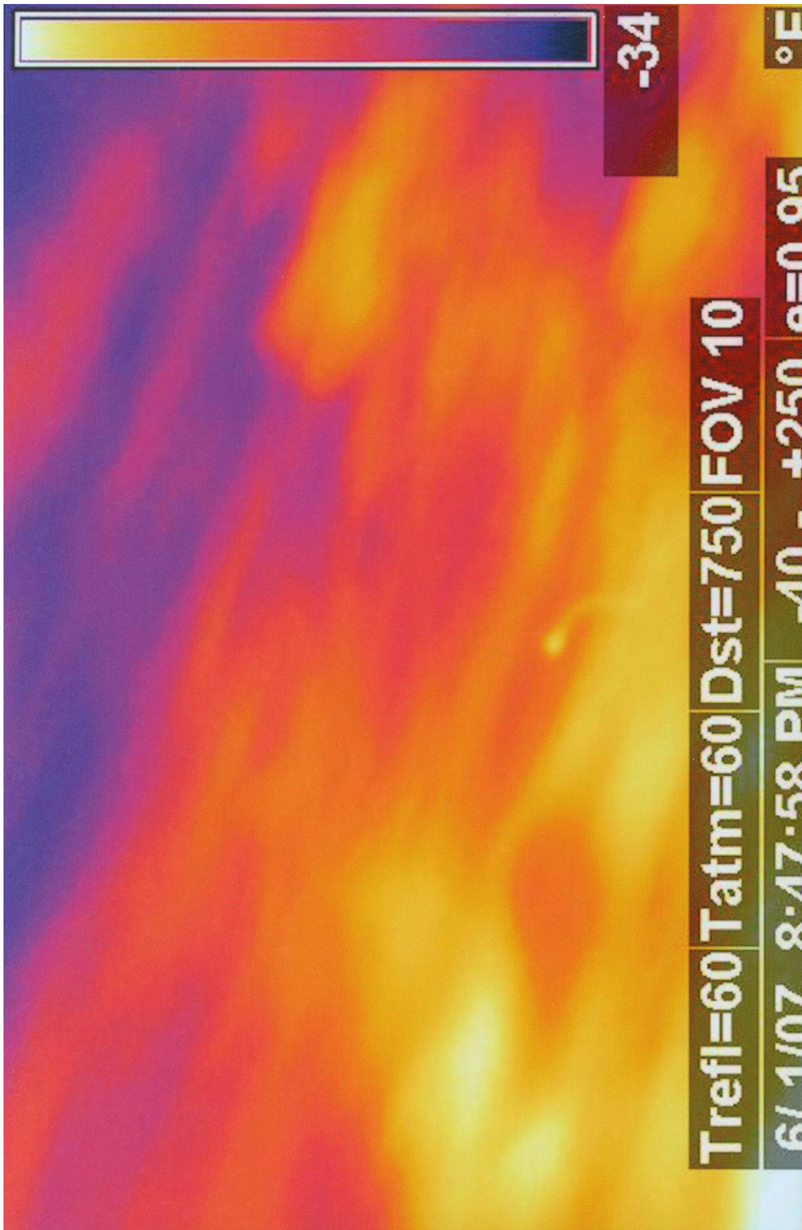


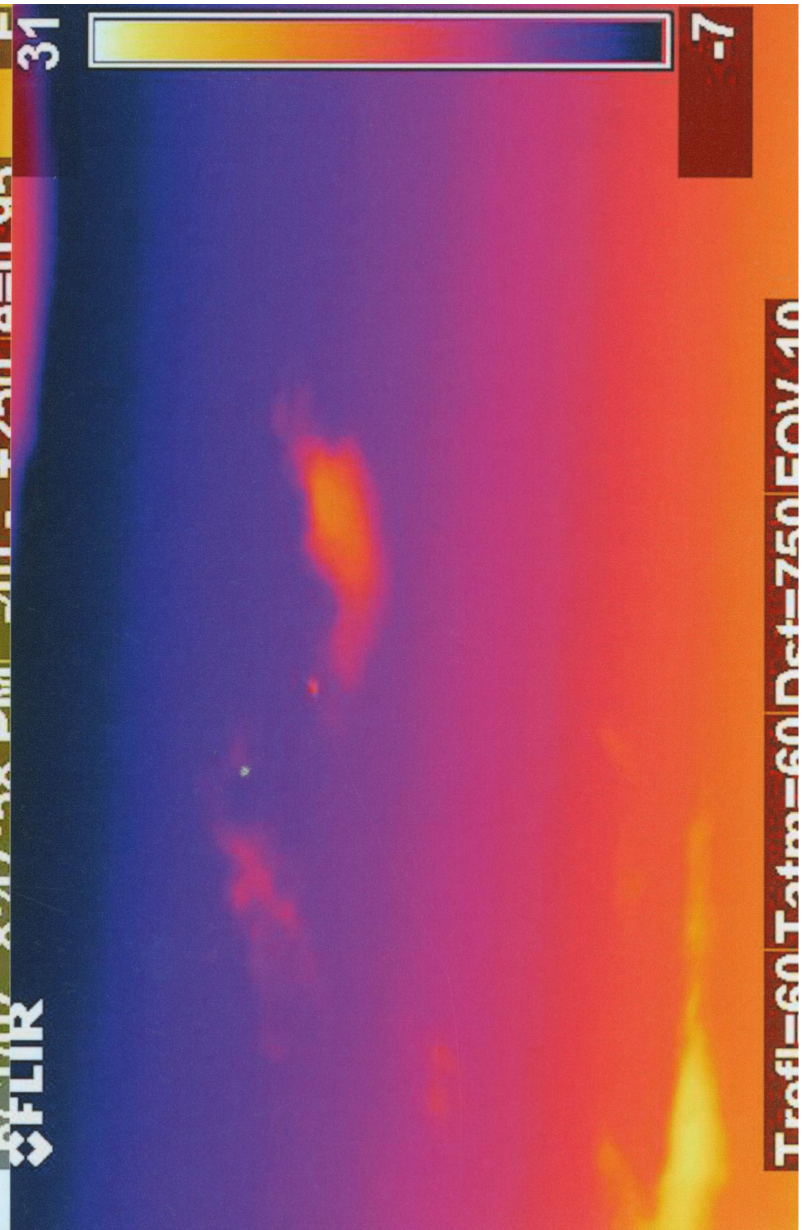
Picture 29. Captured at: Moon S.E. of location magnified 4 x
Date & Time: 6/1/2007 10:33:15 PM

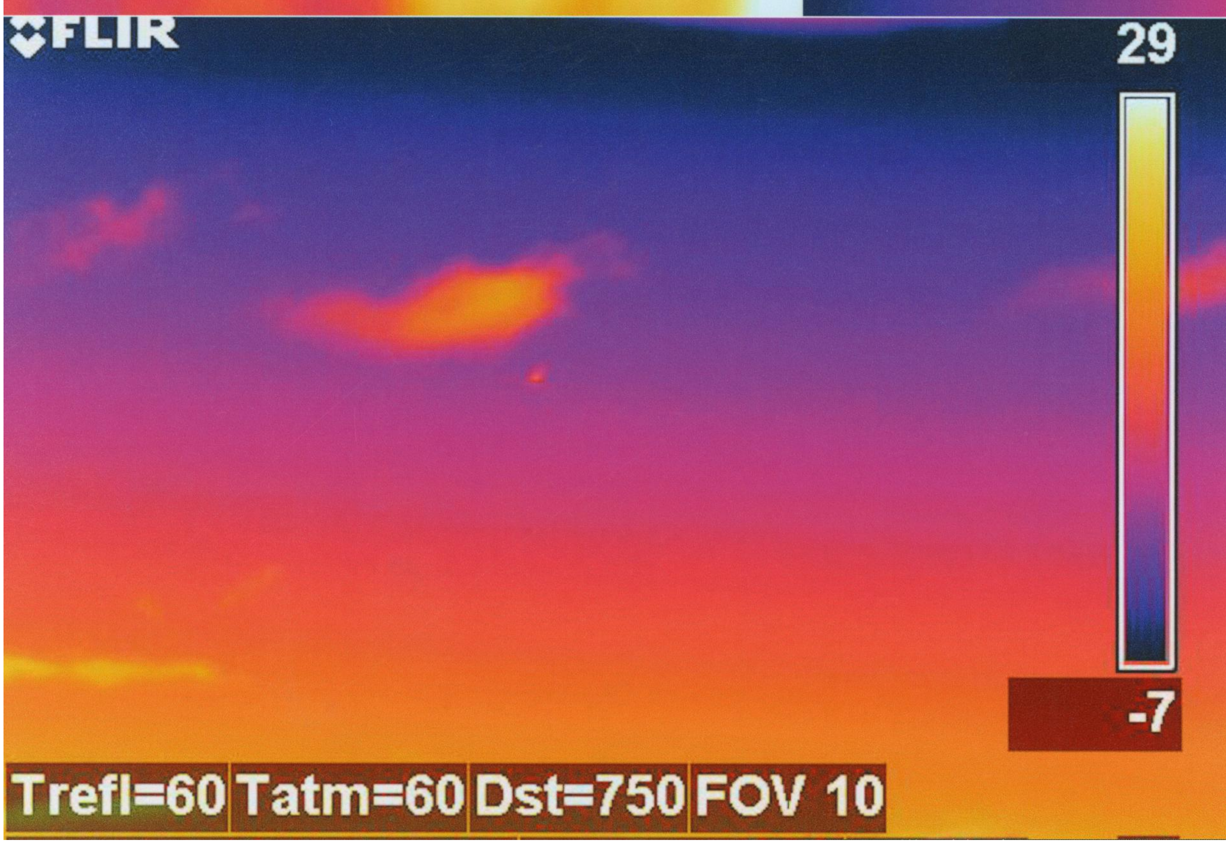


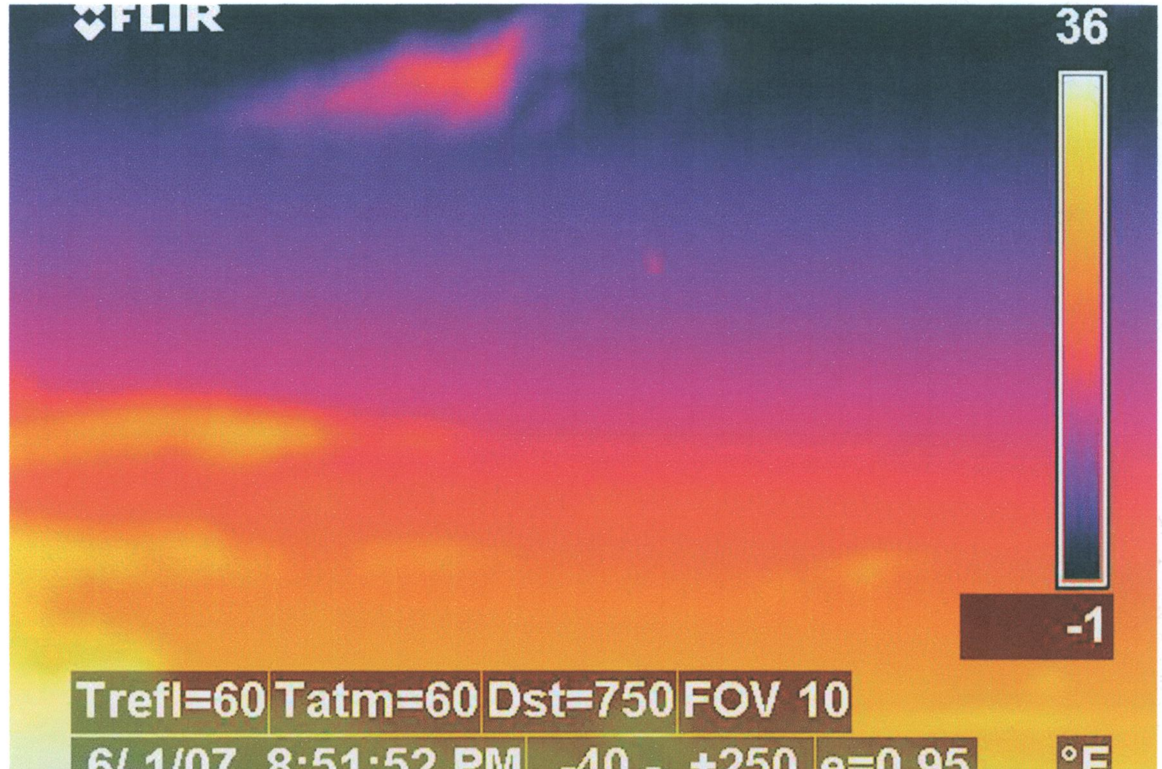
Picture 30. Captured at: Moon-S.E. of location, no magnification.
Date & Time: 6/1/07 10:34 p.m.

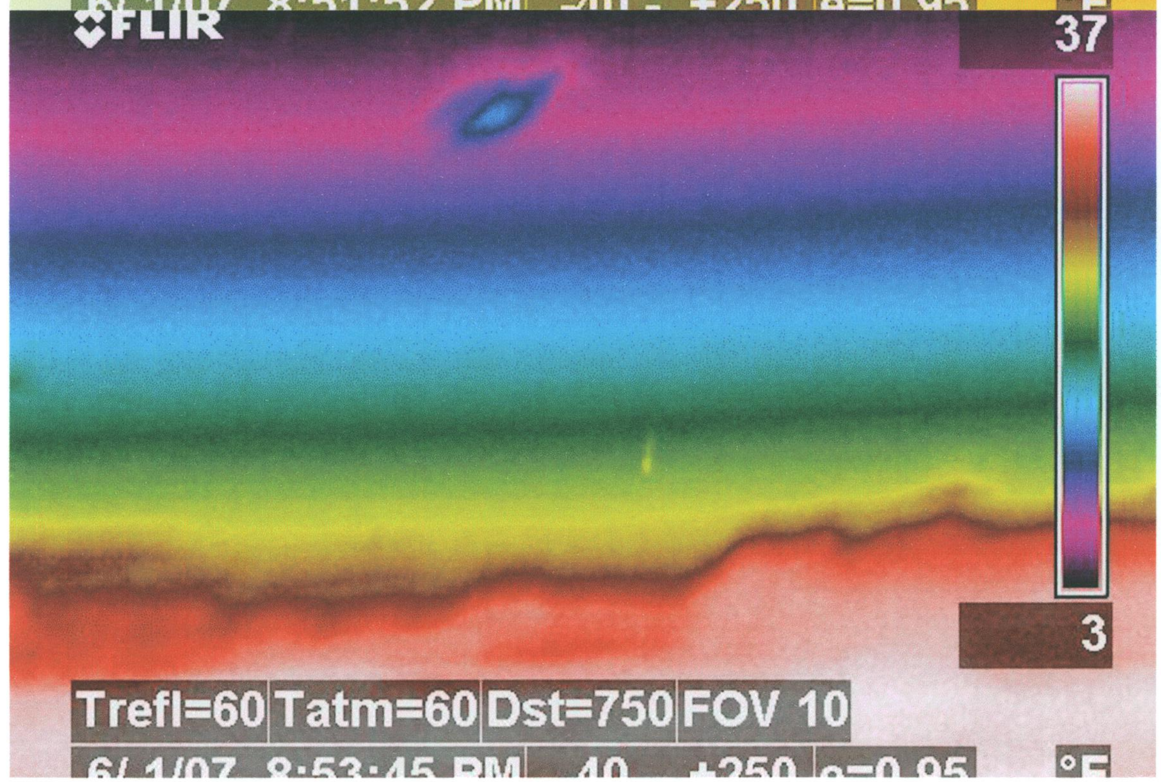



-34
°F
Trefl=60 Tatm=60 Dst=750 FOV 10
6/1/07 8:47:58 PM -40 - +250 e=0.95

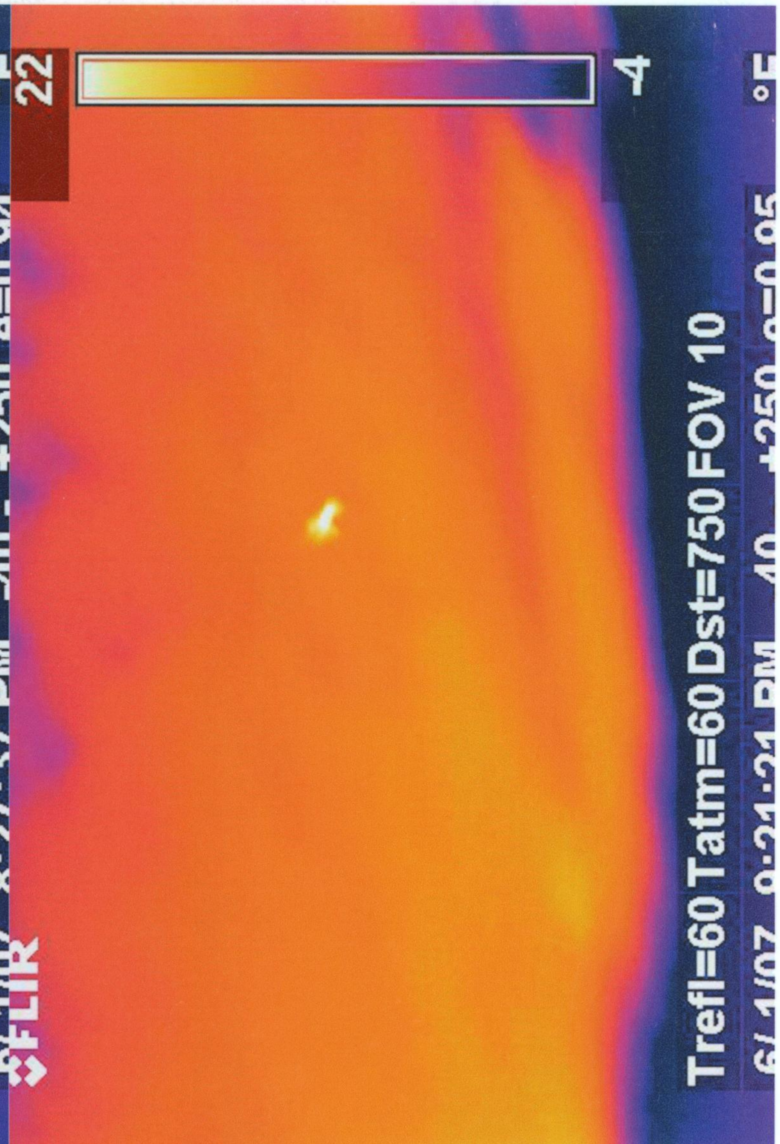

31
-7

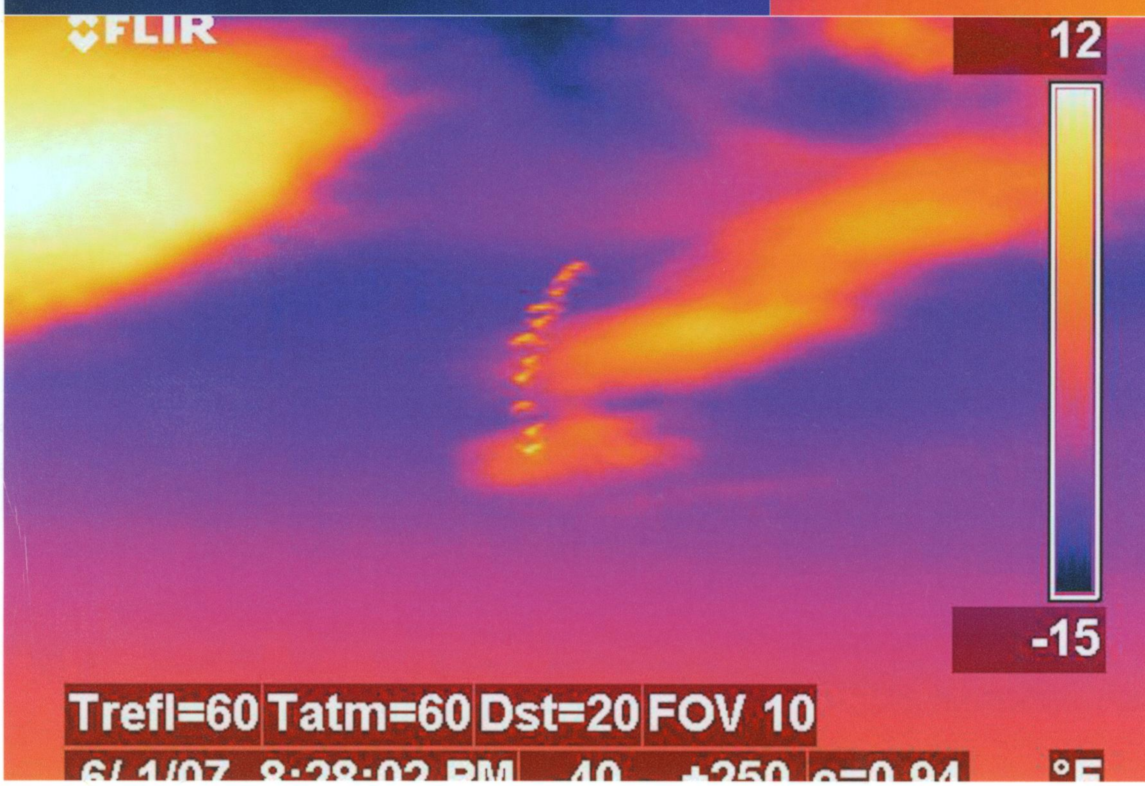

FLIR
29
-7
Trefl=60 Tatm=60 Dst=750 FOV 10


FLIR
36
-1
Trefl=60 Tatm=60 Dst=750 FOV 10


FLIR
37
3
Trefl=60 Tatm=60 Dst=750 FOV 10


13
< -49
°F
Trefl=60 Tatm=60 Dst=20 FOV 10


22
4
°F
Trefl=60 Tatm=60 Dst=750 FOV 10


12
-15
Trefl=60 Tatm=60 Dst=20 FOV 10